Health Management Information Systems

RESOURCE PERSONS' MANUAL

VOLUME 4

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NATIONAL RURAL HEALTH MISSION

राष्ट्रीय ग्रामीण स्वास्थ्य मिशन

Foreword

This book took a long time in the writing. It began with a five day workshop held in Delhi in March 2011, where a number of leading practitioners and academicians of health information systems participated. It has since gone through a large number of discussions and rounds of editing. And even now its content should be read as thoughts on an evolving theme, rather than as a final statement.

This book is the fourth – and the last – of a series of four books, written at one level as mundane training manuals, but at another level as theoretical explorations into one major aspect of knowledge management for public health. By making this book so context-specific we have compromised its ability to act as general theoretical work. But that is the choice we have had to make. The primary purpose of these books is to inform and empower those decision makers and programme managers who act as resource persons and provide technical assistance to the development of health information systems in the states and at the national centre.

For those who have been following our earlier books on HMIS, and for all those who are involved in managing health information systems under the national rural health mission, it would make sense to start with the first chapter and proceed sequentially to the last chapter. The first five chapters deal with the nuts and bolts of such "routine" and dull problems as data quality, the choice of indicators, the design of primary registers, capacity building strategies and use of information. But we also try to theorise the problems we have faced in implementation and our learning's in HMIS over the last five years in these technical details. Then in the next chapter- chapter 6- we touch upon areas of HMIS reform that remained on paper, wondering why it did so. We then pass on to two chapters where we transit from the nuts and bolts discussions to the questions that relate to the larger "architecture" and objectives of Health information systems.

But for those who are more interested in the theory of Health Information Systems, or one who works in designing HMIS, one could begin with chapter 8 and work one's way backwards to the first chapter- a sequence that is also logical and useful to understand the issues. These two chapters – 7 and 8, attempt a general theory of the relationships of HMIS structure and functions and discussed how theoretical, even ideological aspects, affect design issues. And all the while we attempt to keep the discussion at a hands-on practitioner friendly level.

Finally in the last closing chapter 9 we deal with the agenda for the development in the health information systems in the coming years and the new roles that national and state public health leaderships must play in its development, and also the challenges faced in providing technical assistance for this change.

We take this occasion to acknowledge all those who have helped, not only in writing this book, but in partnering us in this journey. In particular we place on record the unsung work done by the "HMIS fellows" who have worked behind the scenes to help implement the programme in the states, and the students, volunteers and consultants of Health Information Systems Project, India, who in the course of overcoming the daily problems of managing such a system have generated a rich legacy of knowledge that we have made use of for this book. We duly list the names of all our other partners in the annexure, and place on record our immense gratitude for their support.

Finally a word about why we have introduced the term "HMIS reform", instead of just calling it HMIS development. In much of public health policy, HMIS is projected as one of the tools or components of health sector reform. The introduction of HMIS is perceived as leading to improved effectiveness, efficiency or accountability of the public health sector. HMIS is often perceived as introduced for the first time and its deployment as necessarily and inherently contributing to the reform process. Other earlier efforts at building HMIS are either conveniently forgotten or just dismissed as false starts.

In the approach that this book takes, use of information for programme management, is recognized as being as old as the health sector. Even computerisation of HMIS with all the components of current Health Information Systems, is at least 20 years old. In our understanding, the problems in setting up an HMIS that works, reflects the problems that we face in getting the health system to function more efficiently- and both reforms have to move in parallel. These problems of public health systems have something to do with resources and something to do with governance- but there are deeper problems that are embedded in the very design of systems. Understanding the problems of HMIS and reforming it, would thus contribute to and become a part of the larger process of understanding and addressing the design challenges of crafting effective and equitable public health systems.

Needless to say, the views expressed herein are views of the authors and cannot be attributed to NRHM or to the government. They are published under NRHM, because NRHM recognises the importance of a much wider technical discussion on HMIS design and the design of public health systems. Technical support institutions like NHSRC are not meant to be passive conduits for the application or dissemination of knowledge generated in the international knowledge metropolis. They are active and sovereign sites of generating new knowledge and innovation which emerges from, and is integrated with the daily tasks of problem solving and technical assistance.

Dr. T. Sundararaman
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Contents

1 Data Quality Causes & Action

In this chapter we shall learn:

a. The current situation in data quality and the common causes of poor data quality.
b. Methods of assessing data quality.
c. Measures we need to take to address quality issues.

The Current Situation

Three years after the start up of the HMIS reform under NRHM, monthly "data entry and uploading" from every district into the national web-portal has been stabilized and occurring without a break.

Every month, service providers in every sub-center and primary health care facility and hospital managers in larger facilities, compile details of service delivery and information regarding some key health events in the form of aggregate numbers and enter it into reporting formats. These formats then flow to block or district level, where they are aggregated into block or district aggregated reports. The district aggregated reports are "uploaded" on the national web-portal – a central repository of all the health information from all the public health facilities and an increasing numbers of private health facilities as well. Given the fact that there are over 190,000 reporting units in the nation, organizing the flow of information on a regular basis from 640 districts of the country was an immense challenge. This objective is now achieved.

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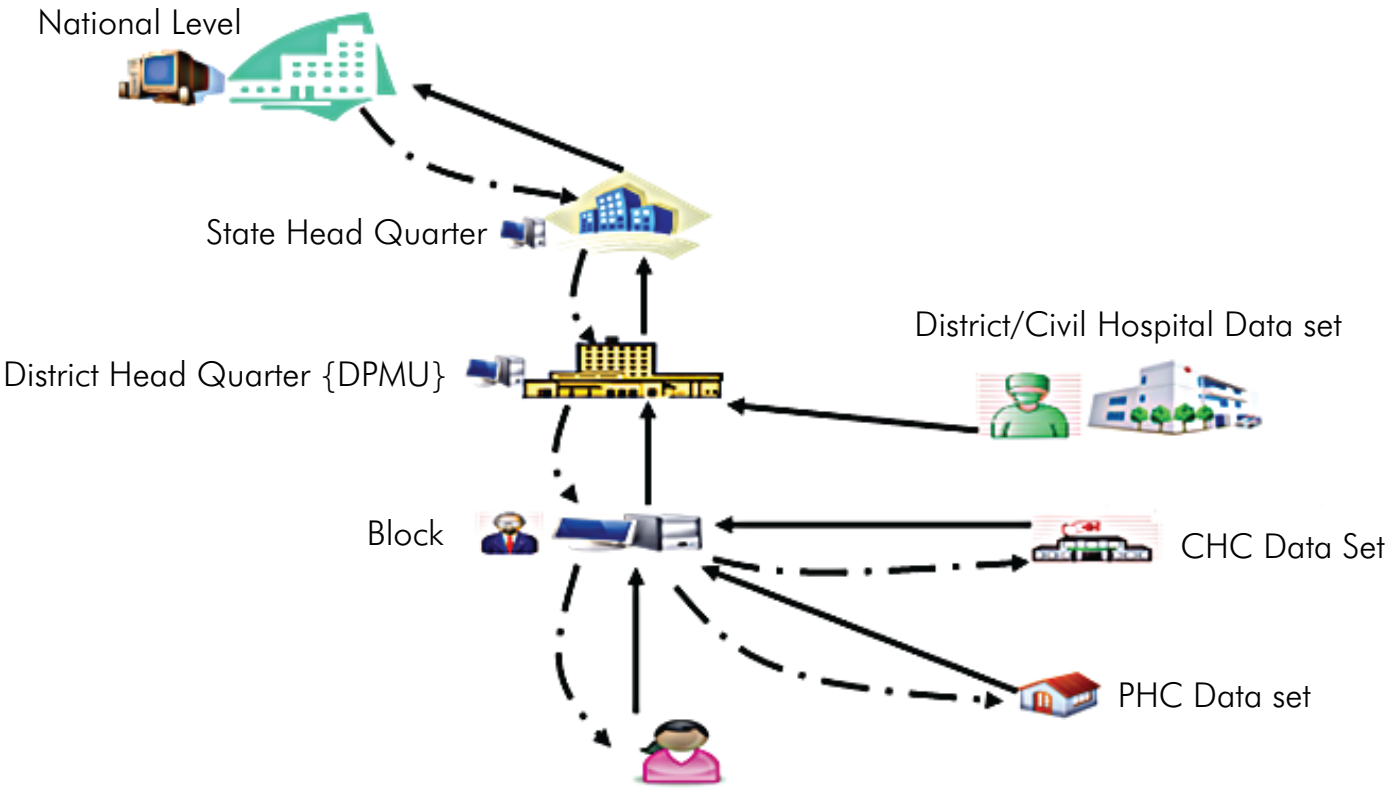
The attention has now shifted to improving data quality.

The causes of poor data quality are assumed to be due to a) data entry errors b) lack of training c) false reporting. Though there is some truth in these perceptions, these factors are only a small part of the problem and even these three are poorly understood and incompletely addressed.

Figure 1



We also hope that this chapter leads to a breaking of the vicious cycle set up between poor use of information and we also to poor data quality. Use of information is the most important step for Use of to improving data quality

To detect data entry errors two approaches are used. One approach is to run a check for logical inconsistencies or what are called validation queries. Thus, for example, the 'total number of women discharged within 48 hours or after 48 hours after delivery' cannot be more than the 'total number of women who had institutional delivery'. The other approach is to plot the data trends and then look for what are called "statistical outliers". When a data element fails a validation check or is pointed out as a statistical outlier, it is expected that the HMIS managers would check the data, and detect and correct the data entry error. Periodic reviews of the data carried out in national and state workshops are also used to point out possible flaws in the data values. These measures have helped to get HMIS managers in states to read their data and correct some of the errors. But this did not solve the problem of poor data quality.

There is little clarity on how exactly training helps to improve data quality since "uploading" is anyway well done. Lots of training camps were organised and while it helped revise the skill of uploading on the applications, and use of validation checks, many of the quality problems have remained.

Perceiving the problem to be mainly due to false reporting, there have been discussions on how this can be checked. One way of thinking is that

since only aggregates are reported, it is difficult to know whether the figure is true or exaggerated. But if the programme manager could potentially see the name of each beneficiary or atleast the dataset from each facility, there would be less scope for false reporting. This led to a insistence on service providers providing names and individual details of services delivered-what is often referred to as name based reporting. But name based reporting-or pregnancy and immunization tracking, as it is also called, became parallel to HMIS brought many quality problems of its own. Similarly there is no evidence to believe that introduction of facility as unit of reporting has reduced false reporting or increased data quality. While increased 'granularity' of data is potentially welcome, given other systemic constraints a premature shift to a facility-based system can threaten even existing information flow.

This chapter summarizes the NHSRC's learning from the field in improving data quality and provides an understanding of the causes as well as the tools and methods through which every district/state can improve the quality of data they use.

We also hope that this chapter leads to a breaking of the vicious cycle set up between poor use of information and we also to poor data quality. Use of information is the most important step for Use of to improving data quality. But when programme managers find low reliability for the data, they stop trying to use it. And when there is little use being made of it, then data quality further worsens. On the other hand if an intelligent programme manager tries to use the data, then not only do they notice and correct errors, even errors would have valuable information about gaps in the programme. But for this to happen, programme managers as well as HMIS managers need to understand these issues of data quality.

A Working Definition of Data Quality

Data quality is an attribute of data that makes it reliable and useful for decision making. Or in other words how much can one trust the information it provides and base our decisions on this. The quality of an indicator is determined by attributes such as validity, precision, sensitivity, specificity, reproducibility and feasibility. These attributes apply to data elements also. But in this chapter we are assuming that the HMIS has chosen its data elements and indicators well and we only discuss other determinants of data quality.

An Approach to Data Quality

The determinants of data quality are best seen as a composite of issues pertaining to organizational processes, procedures or processes followed, and institutional capacity. What is needed is first to identify why data is of poor quality and then using a root cause analysis, diagnosing the specific causes which have led to the problem. This analysis could be facilitated by

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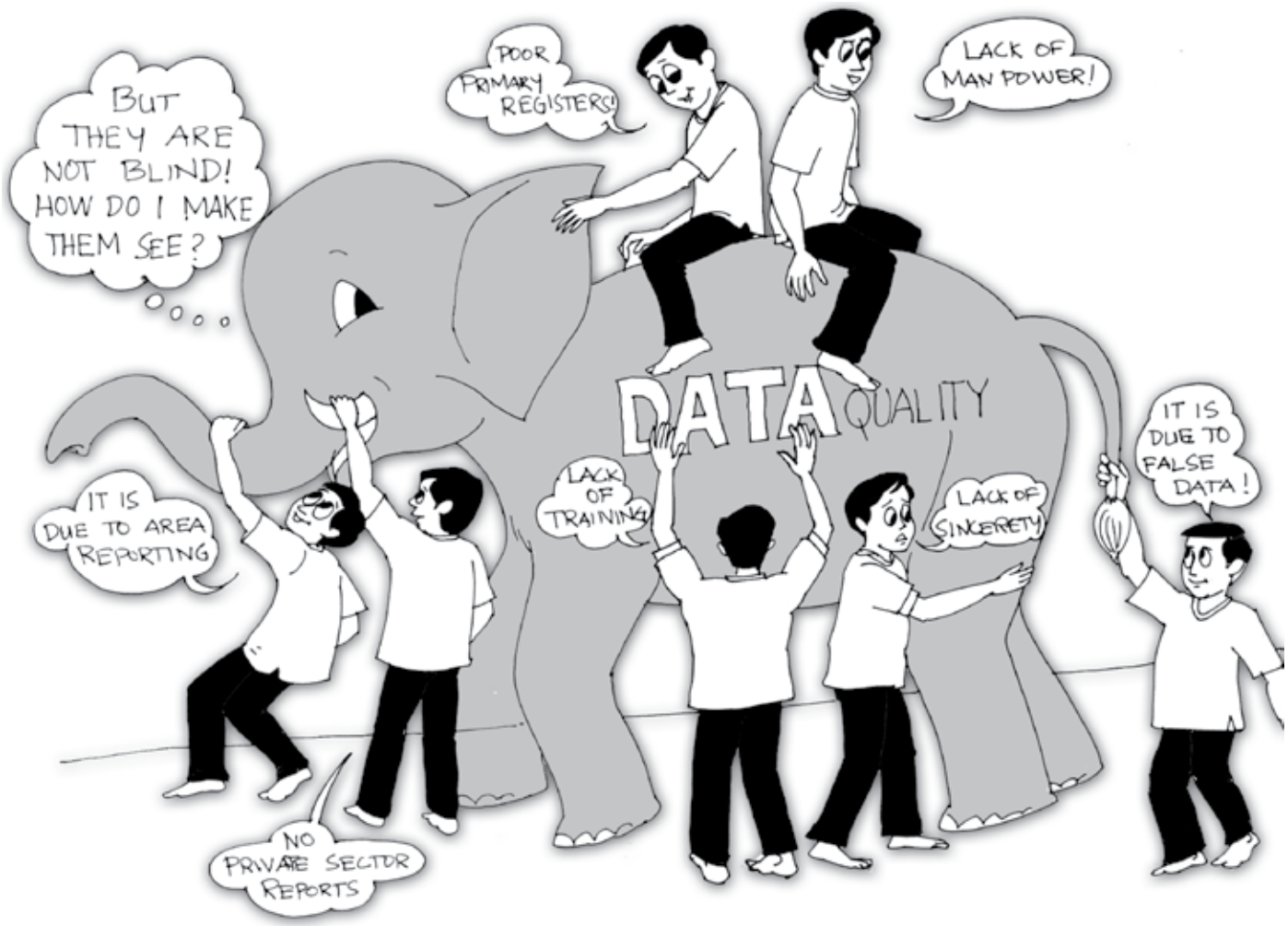
suitable tools. The caution is not to pick on just one of the multiple causes, like the blind men and the elephant and assume that the whole truth of data quality lies in that one factor. In reality there are almost multiple contributory factors and we need to identify and address all of them. We discuss the causes of data quality below.



Dimensions of Data Quality

1. Completeness of data reporting

There are three types of incompleteness:

a. Most common is the absence of private sector data. Private clinics and nursing homes do not send in data.

b. Sometimes geographic areas like city corporations or company townships or some facilities get missed out.

c. Some of the public facilities that are expected to report- fail to do so.

Whereas the first two are relatively constant patterns the third could change randomly. All of them are a constant source of underestimation of health events and health service delivery.

The first two gaps would not affect use of the data for public facility management, but it would affect our assessment of health status and access to services – overall in a district.

Immediate Action: Identify and explicitly state the potential reporting units from which data is not currently collected and if possible exclude that population from the denominator. The software in use must automatically report the number of non reporting units- along with each monthly report.

If possible exclude that population from the denominator. The software in use must automatically report the number of non reporting units- along with each monthly report

Intermediate Action: There must be a drive to mobilize all private clinics and area authorities to report on these same forms- and to create space in the software applications to receive and aggregate data from these new reporting units which are added on.

Long term Action: It must be mandatory for all private health care facilities and private health authorities to report data which is of public health importance.

2. Adequacy of reporting (or completeness of reporting-2nd dimension)

This is another sort of completeness of reporting.

A sub-center report has 77 data elements. Of these, there are a few where one usually expects a zero report e.g. immunization preventable diseases, adverse effects of immunization etc. This is about 10 percent of data elements. The others should usually not be a zero. In PHC there are over 220 data elements and the data elements that are usually reported as zero are 15-20 percent. The rest should not have a zero report. Yet in most states, over 60 percent of data elements in both the sub-center and in the PHC forms are reported as zeros or left blank. This means that many data elements are not collected and reported. In some districts the zeros could be as high as 80 percent.

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Box 1A gives the data elements which one expects a zero reporting, all other data elements should be non zero.

Immediate Action: District HMIS appraisal visits should study the facility reporting forms and the district aggregate forms and find out which data elements are reported as zero. Then check whether the zero calls for a programme management action or a HMIS data quality improvement action. Thus if a number of facilities report zero for anemia in pregnancy it may be that they do not have the equipment to do the tests - which calls for programme management action- or it may be that they are failing to record and report anemia in pregnancy which is a HMIS data quality action. In a

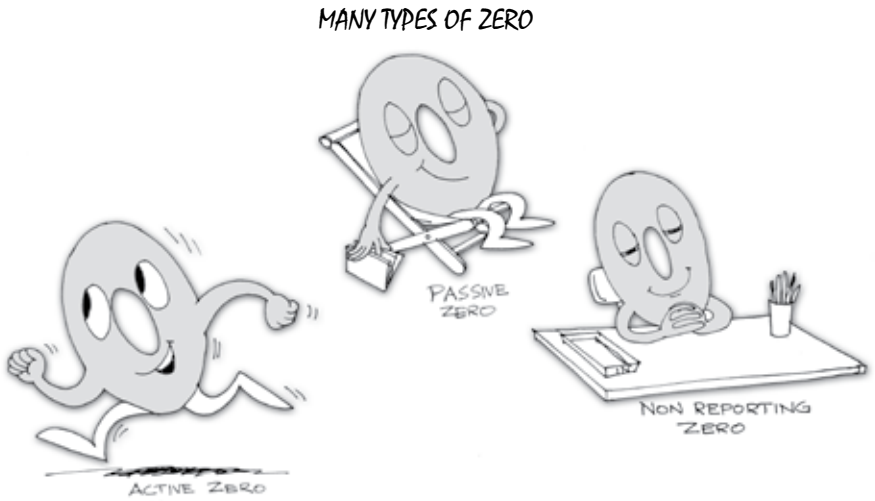
There is a need to check whether the zero calls for a programme management action or a HMIS data quality improvement action

training session, it is good to ask HMIS managers to look at the records they receive and compute the total percent of data elements which are reported as zero, and the percent of data elements which should normally be non zero but which are being reported as zero.

Intermediate Action: The applications you use should be able to give a data completion report which informs what percent of data elements have been reported as zero.

Box 1A List of data elements typically reported as zero

List of data elements where 'zero' would usually be a correct statement for most CHCs	List of data elements where 'zero' must be non-reporting for most CHCs
■ Number of wet mount tests conducted ■ Number of Centchroman (weekly) pills given ■ Number of Emergency Contraceptive Pills distributed ■ Mortality details ■ Number of eyes collected ■ Number of eyes utilized ■ Number of children more than 16 months who received the MMR vaccine ■ AEFI - deaths ■ Childhood Diseases cases - diptheria, pertussis ■ Number of cases where Janani Suraksha Yojna incentive paid to • ANM or AWW (only for HPS States)	■ Mid-night headcount ■ Quality in sterilization service • Number of complications following sterilization • Number of failures following sterilization • Number of deaths following sterilization ■ Adolescent Counseling services ■ Pregnant women treated for severe anemia ■ Number of deliveries at accredited private institutions ■ Number of MTPs conducted at private facilities ■ AEFI – Abcess and others ■ Total number of times the ambulance used for transporting patients during the month ■ Number of cases of childhood disease reported – diarrhoea and dehydration ■ Number of school children detected with refractive errors



3. Timeliness of reporting

There is a given schedule for reporting. All facilities should report by the 5th of the month and the district should report by the 20th. If there is a delay, then data from that unit gets excluded or it gets reported along with the next month's data, or it delays the reporting from the next higher level. When data is excluded and/or gets reported with next month's data- all trend analysis and monthly interpretation gets affected, usually in a random manner.

Immediate Action:

a. Put in place rules for correction of data and entry along with next month's data.

b. Good review of timeliness of reporting by the district officer would also help identify problems - infrastructural or human resource - in facilities and attend to it.

Intermediate Action: The applications must capture and communicate non reporting units and units reporting after delays.

Long term Action: All facilities are computerized and if they enter their data by the 5th of every month, then by the 6th of every month, all block and district reports can be generated. This would save 15 to 20 days and make reports far more timely. Further, since sub-centers would be difficult to computerize, if sub-center data can be transmitted by sms from a specially configured mobile then one can even get all the data entered into system and a final report can be generated by the first or second of each month. Not only is such speeding up of the data flow technically feasible, this has been achieved in some of the states.

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4. Errors due to poorly designed primary registers - missing elements, computation feasibility

About 30 percent of data elements that an ANM needs to report on are not present in her primary register. Or else they are present, but recorded on a

The poorly designed recording register is perhaps the most common cause of poor quality of data

day to day basis in such a way, that it is difficult to add up and arrive at a total for reporting at the end of the month. The poorly designed recording register is perhaps the most common cause of poor quality of data. Often service providers just write a "best guess" figure because there is no way they can actually compute the actual figure. Issues related to design of primary registers are discussed in detail in chapter-6 of this manual.

This problem is even more acute in large hospitals where different units need to have well designed primary registers and there needs to be a system of collecting data from all the units and aggregating it into the facility report.

Immediate Action: Examine primary registers for missing data elements and send a circular to service providers to add these in.

Intermediate Action: Optimize design of primary registers – recording registers for all facilities. Put a hospital information system in place in all district hospitals and other facilities with in-patients.

The single most important step is creating a data dictionary and then making it widely available to all service providers

5. Data definitions and misinterpretation, consistency of terms used

The term is either interpreted wrongly or differently by some or all the providers. This leads to major errors. We give examples of this in Box 1B

Immediate Action:

a. The single most important step is creating a data dictionary and then making it widely available to all service providers reporting data and to all HMIS managers managing the data and to programme managers using the data.

b. Training: The first training manual of the NRHM- NHSRC- training on HMIS series has done precisely this. Further, the training manual

Box 1B Examples of misinterpretation of data elements

1. **Total number of pregnant women given 100 IFA tablets:** Number of tablets given to pregnant women is reported instead of number of women given 100 IFA tablets. This leads to an absurd figure being reported. This is clearly a wrong interpretation
2. **ANC Hypertension- New cases detected at institution:** As data definition is not clear among reporting staff thus usually they report all ANC hypertension cases identified at the facility in a particular month, even if the same woman has been recognized and reported as hypertensive in the earlier visits. This misinterpretation practice needs to rectify with the help of proper training.
3. **Number of pregnant women having Hb level<11 (tested cases):** Whether to include old cases or not.
4. **Institutional Delivery:** As separate reporting of caesarean section deliveries exist in the reporting format, this create confusion among reporting staff that whether to include C-section deliveries in institutional deliveries or not.

also has a set of 100 evaluation questions each of which expose and clarify common misunderstandings as detected from our field work. Ensure that every service provider is trained and certified as having passed in this competency

Intermediate Action: A State which has internal capacity to manage its own HMIS should be able to periodically review and detect data definitions related errors from examination of the data and from field visits and then write these errors into the next training sessions. It should also communicate to its employees-through circulars and simple posters put up in review meetings, the common errors occurring with regard to data definitions.

Long-term Action: As private sector units start reporting; these units would also require training, and hand-holding to make the system work.

6. Data aggregation problems - both random and systemic

When adding the data elements from so many facilities to construct the block or district aggregated form, errors are inevitable. Since a district has over 400 sub-centers, 40 PHCs, 10 CHCs and a DH, adding all these up manually is cumbersome and prone to error. Most of these are random errors of small magnitude and difficult to detect- but even when most carefully done there would be a 1 to 5 percent error.

When a single data element is collected as multiple disaggregated elements the computation errors start increasing geometrically and could seriously compromise the reliability of the final data element. For example, if we collect the data element "number of children given BCG" from each subcenter and add up the 400 sub-center data to arrive at district figure for total number of children given BCG, we would have an error in manual addition of these 300 numbers. Let us assume it is an error of 3 percent - which is quite manageable. But if we collect BCG given for males and for females and for SC, ST, others, and for below 1 and above one- all separately then we add not one but 12 columns of data and with the same range of error in addition of each column of data our eventual error could be close to 36 percent off the mark!! (That is if all the errors were in one direction- in practice there would be considerable cancellation of errors).

When each of the facility forms are entered separately and the addition is completely computerized, the addition of wrong fields would lead to a systematic and recurring error. Errors due to disaggregated data elements would be much less, but still at the point of collection and reporting they would persist.

The second type of aggregation error, is when facilities are missed or added twice or added to the wrong block/group. Often the names of a number of sub-centers are missing in the software application or appear in another district. Such errors are common- and they are very difficult to solve- as the software applications manager is very difficult to reach and there is

Problem of primary registers is even more acute in large hospitals where different units need to have well designed primary registers

When a single data element is collected as multiple disaggregated elements the computation errors increases geometrically and could seriously compromise the reliability of the final data element

very little time or patience that anyone has for trouble-shooting this type of problem.

Immediate Action: HMIS managers should be asked to identify and report facilities missed out or wrongly added and then one can edit the software accordingly. But for this to happen there must be a higher awareness on the existence of such problems.

Intermediate Action: Limit the number of disaggregated data elements in use for now. The level of computerization needed even at the primary register level to eliminate all manual aggregation errors is still in the future. Ensure that facility level data are fed into the computer and the aggregation is done by the computer.

Note: There is always much pressure from policy makers, to provide greater and greater dis-aggregations of data- by gender, by caste, by urban-rural divide, by religion, by economic status etc. Each disaggregation greatly increases the burden of reporting, and seriously compromises the quality of data. It would not do so if service providers maintained an electronic primary record and case record for each service user- but that requires a much higher institutional capacity than we have built up today. For the present the disaggregated information that is essential for policy purposes must be gathered from sample surveys.

7. Data entry errors

One guiding principle is to reduce the necessary amount of information to a minimum data set

These are either careless error that occurs in low frequency in random, or they are systematic errors that occur because data entry is made into the wrong box… usually the neighboring one.

These are best picked up by the device or running validation checks which is based on checking for logical consistency is between different data elements. A large number of validation checks are in use and one

can benefit from it. Applications have also been configured to state whether they ran validation checks or not and if they ran- how many data elements failed the test.

Though absurd entries and errors that lead to failing validation checks are picked up, lesser errors which may still be significant escape notice. Important to therefore store the original paper forms received at the data entry point and then have random verification of the quality of data entry. Such a process is not in place in most states.

The other major problem is that data entry operators do not understand the data. The data entry operators are usually social science or science graduates with basic computer skills. They have no understanding of public health or the data they feed in. HMIS managers are also usually from similar backgrounds, but at higher levels they could have statistics and demography backgrounds. There is almost no supervision from public health experienced persons, and there is minimal training on the meaning of the numbers that is given to the data entry operators.

Immediate Action:

a. Training on data elements and their meaning to data entry operators, using the data dictionary.

b. Validation checks which are available on the data entry screen itself, points out obvious errors of data entry, at the time of data entry itself.

c. Periodic review of data at district and state level.

8. Confirmation and error management procedures and guidelines

Some errors are inevitable. There should be an accepted and notified procedure of how errors are corrected or managed. We give below the example of one common error – and its management protocol.

"Facility A delayed its report for May 2011 because the block – level data entry operator left the job suddenly and it took two months to find the replacement. The forms of data received from the sub-centers and PHCs in that block were not even added up. Meanwhile the block consolidated the data from all its other facilities for May, June, July, August and sent it up to district which added the data without the data from facility A into the web-portal. In September, the facility A started reporting again and wanted permission to add in all the data into the September month- since the data of previous months was locked.

Protocol was consulted and it recommended the following:

a. May, June data is of the first quarter and for this permission may be taken from the state data manager and the June data unlocked and the data of this facility is added into it.

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Some errors are inevitable. There should be an accepted and notified procedure of how errors are corrected or managed

DON'T FIX THE DATA, FIX THE PROBLEM

Guidelines on error management should mandate that every change being made is documented in an error correction register which records: What figures was changed to what, why and who asked for the change who authorized it and what protocol rule number was it done in accordance with

b. July and August data is of the second quarter and this data could be added into September data as the data analysis is done on a quarterly basis- and a "bump" in one month would not show. Data of May and June cannot be added in September because they belong to the earlier quarter.

c. If the error had been detected only in November, the first quarter data would have "gone public" and the facility A data for May and June would have been locked such that corrections were no longer possible. The facility A data would then be added in a column called delay correctives and there it would have remained, until aggregated into the annual data.

d. A similar rule would apply to annual closure of data. March figures reported late cannot be added to April data, even temporarily.

Note: This example is imaginary- no such protocol exists. This is only alerting states to the need for such error management protocols. Other common causes of error are data entry errors and data aggregation errors that were noticed later when running validation checks or information was being put to use.

Immediate Solution:

Guidelines on error management should be introduced at the state level:

a. Guidelines on standard error correction protocols for all frequently occurring errors and problems should be issued.

b. Guidelines should specify authorization of who is responsible for verifying and confirming the data and how this is done- at facility, block, district and state level.

c. Guidelines should mandate that every change being made is documented in an error correction register which records: What figures was changed to what, why and who asked for the change who authorized it and what protocol rule number was it done in accordance with.

9. Logistical problems

Underlying many problems of data quality are gaps in infrastructure. A district aggregated report may show poor performance on a large numbers of data elements because a number of reporting units have not sent in their reports. To the district programme manager this is data of poor quality since he/she cannot rely on it. But underlying this may be infrastructure and logistic gaps.

There are four problems that we draw attention to under this head:

a. Lack of computers

b. Lack of full time trained data entry operators

c. Lack of internet connectivity

d. Lack of effective applications.

These are discussed with capacity building. Each of these would lead to non reporting or delayed reporting from those reporting units. This would lead to delayed reports and loss of completeness of reporting- but other dimensions of data quality are less affected by this.

10. Data duplication and the issue of area reporting v/s service delivery reporting

This is the most resistant and universal of all the problems.

Many events get double counted. The most common reason for double counting is asking the ANM to report all events that happen in her area- irrespective of whether she has provided the service or not. This is known amongst practitioners as "Area Reporting". The opposite of this is "Service Reporting" where the ANM reports only the services she provides. Thus an ANM would report only of those cases she inserted an IUD for. If she knows that another woman in her area has had an IUD inserted at the private sector or in the CHC, she would not report it- so that this is not double counted.

Another example: An ANM reports ANC that she has done for a pregnant woman. The third ANC of that woman is done in the PHC. The PHC will report it-often as a new pregnancy registered. The ANM would report it as a third ANC done. Ideally only PHC should report it as the third ANC- for which they could have referred to the pregnant woman's registration card and number. However this does not happen and in most districts ANC reporting is well over 100 percent despite the private sector data not being added in.

Data duplication… is the most resistant and universal of all the problems

There is reason to believe that the functionaries on the ground are well aware of this phenomena- but look the other way for one could get a much better performance score without anyone having to tell a falsehood or break a rule.

Name based tracking does not currently solve this problem. Most applications do not have mechanisms of detecting duplication of entries or protocols of how to correct duplication if detected.

Name based tracking does not currently solve this problem. This is partly because name based tracking systems are developed for a different set of outcomes. Most applications do not have mechanisms of detecting duplication of entries or protocols of how to correct duplication if detected. The unique identification number is often non functional and inadequate. But the most important problem is that the data entries on name based systems are so incomplete that they are not currently used for calculating the aggregated numbers fed into the HMIS. The problems of name based tracking systems are discussed separately. The suggestions given below are for situations where data flows only as aggregate numbers.

Box 1C Data element which are usually double counted and over-reported

1. Births
2. BCG doses
3. ANC visits
4. Childhood disease cases

Immediate Action:

a. Sensitize administrators to this issue. There is a stubborn denial of this problem at intermediate management levels which has to be overcome. We cannot and should not accept a situation where over half the care is given by private sector units which do not report into the public health system, and yet the data from public health facilities reaches or even exceeds 100 percent of the expected.

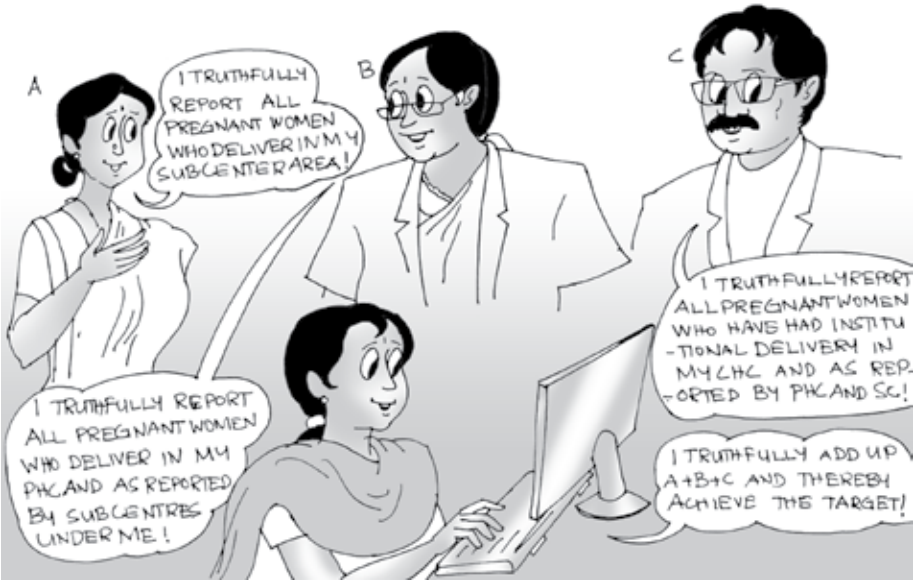
b. Design a primary register which facilitates area reporting as the recording system- but service delivery as the reporting system. This is easier said than done. The NHSRC recommended primary register design has tried to address this issue and it may help if this is used.

c. Put in place a set of orders/instructions as indicated below:

   i. All ANMs should report only those services that they have themselves provided. They should not report on any health events or health service delivery which is happening elsewhere.

   ii. Similarly all PHCs and CHCs should report only on services delivered within its four walls. It should not report on service delivery done in private sector units in their area or on service delivery done by sub-centers working in their catchment area.

One guiding principle of reporting data into HMIS is that it should be 'verified' data. Reporting of service rendered or health events witnessed is verified. Reporting of services or events that the service provider only heard about is not as reliable. This is one reason for insisting on 'service reporting'



iii. Data reporting from private sector units should be strengthened and there should be a separate reporting form for each private sector unit- either a PHC type form if only outpatient services are available or a CHC form where in-patient facilities are available. The applications should show a separate private sector reporting unit for each private sector. Failing which they could have all private sector facilities data added into a single private sector reporting unit for that level. This was the original design but facility based reporting into the web-portal without providing for reporting private sector units separately completely disrupts this design. Merging private sector data into the public sector facility data for that level would lead to a major loss of validity and usefulness of the information generated.

iv. On births and deaths, including on still births- there should be an exception. ANM should report births and deaths at home and at registered/reporting private sector units and non-reporting/ non registered private sector units and public sector facilities separately. Since in the design births and deaths were to be reported as a line list this was not additional burden of work for ANM. It just means that software have to be configured to calculate this disaggregation. Where there are no supporting applications in place, the ANM would have to manually separate "area reporting" of births and deaths from 'service reporting' of births and deaths and report both separately. This double reporting could be used for triangulation at block and district levels. Births and deaths can further be triangulated with data from registrar of births and deaths.

All of this would help only where there is recognition and willingness to avoid duplication. But often, in a target driven scenario, the final numbers obtained by duplication are so much nearer the targets, that it is convenient to all parties, to overlook this error. Change in such a context becomes very difficult.

11. The zero problem – non utilisation, non availability or non reporting

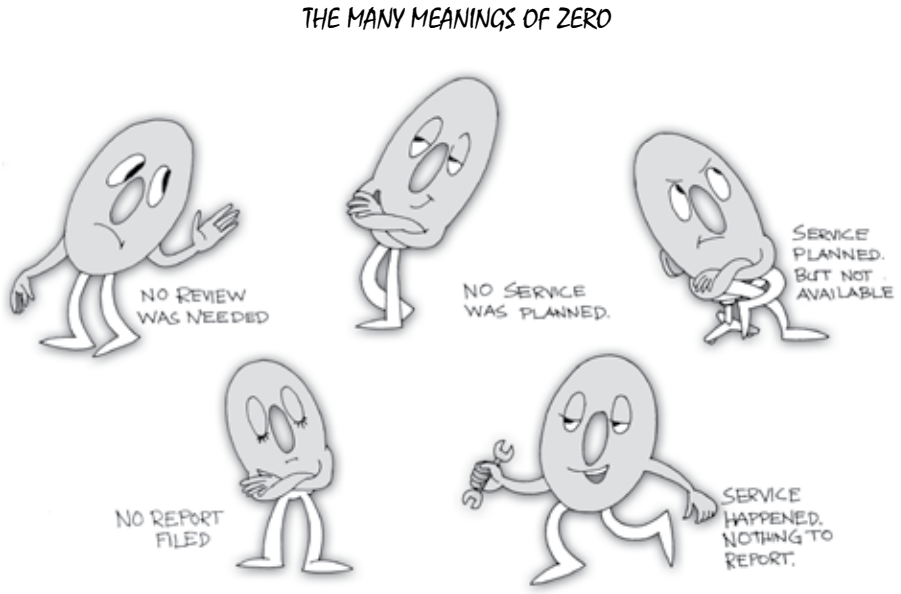
In most districts, more than 60 percent of data elements are reported as zeroes. In some districts it could rise to 80 percent. Zero could mean no services were delivered or event occurred (actively zero), or that this service is not available (passive zero), or that there is a failure to collect data or report (data not known). Some instructions are to report only the active zero and report the other two as blank. But data entry operators tend to put in a zero for a blank – it is very difficult to leave a blank as an active act. Differentially counting zeros from blanks is thus most unreliable. There is also the problem that blanks are read across machines and applications as zeros.

Ideally there should be a separate notation for each type of 0. For active zero- we could write a 0. For effective zero we could write 'Not Applicable' (NA)- and for failure to collect data we could write 'Not Reported' (NR)

Ideally there should be a separate notation for each type of 0. For active zero- we could write a 0. For effective zero we could write 'Not Applicable' (NA)- and for failure to collect data we could write 'Not Reported' (NR). However most applications in use do not allow texts and cannot compute across such entries.

Immediate Action:

a. Calculate the number of data elements that would necessarily not be zero and let the applications compute for each reporting unit the total number of such data elements who were zero. These "necessarily non- zero" data elements- include some of those which



are "active zero", some which are "effectively zero". For example cases of diphtheria reported are zero. That is not an error. But number of patients admitted in a facility with in-patients is zero - this is necessarily non-zero. If it is a zero there is management action indicated- whether it is to improve reporting or to improve admissions and therefore it is worth pointing out.

b. Measure the number of reporting units that reported a non-zero for any data element. Thus 'C-sections are reported in from 2 of the 400 reporting units of the district' or 'Institutional delivery with complications were reported in from 30 of the reporting units' is relevant information in itself and this could be captured by the software.

Intermediate Action: Modify the software to allow NA (Not Applicable) and NR (Non Reporting) entries.

Bottom-line: Report all three types of zero as zero and sort it during interpretation. Also take follow up action to reduce zeros due to non reporting.

12. Death reporting issues - line listing and formats

Death reporting is one of the most important data elements - and the one most frequently under reported

This is one of the most important data elements- and the one most frequently under reported. Information is just as often suppressed from above, as non reported from below.

The main design feature of birth and death reporting, was reporting as line lists. When a service provider or facility reports a death- it sends a list- where there is a name (1) of the dead person, age (2) and sex (3), and his or her ID in terms of fathers name/address (4), and probable cause of death (written in text and as a coded number) and place of death (written as a number and as a code).

Thus one would write:

S. No.	Name	Age	Sex	Spouse Name	Address	Cause of death	Cause code	Place	Place code
1	Kalka	23	F	Sirha	21, Gauka nagar	Bleeding in pregnancy	3	CHC, Birsa	4

As can be seen from the table accompanying- this simple 3 data elements of the list when aggregated, (age, sex and probable cause of death) get reported as a table with 51 data elements

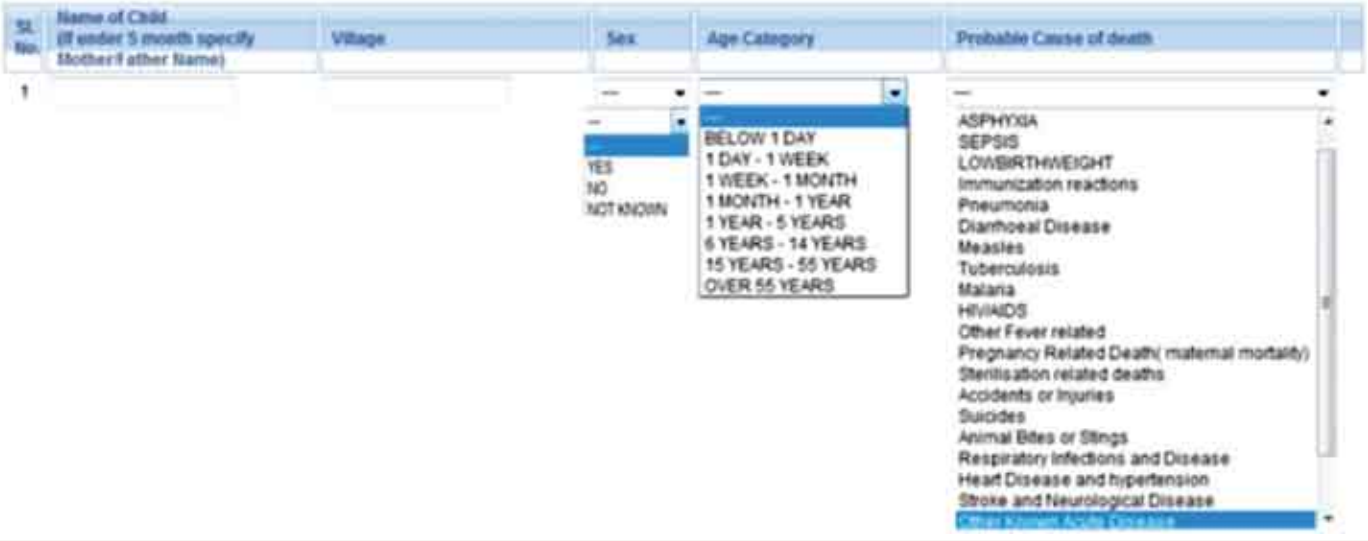
An Appropriate software converts this information from a number of line lists into aggregated data. If reported on the web-portal directly then the information in line lists on paper have to be converted into numbers manually - which is not so simple. As can be seen from the table accompanying- this simple 3 data elements of the list when aggregated, (age, sex and probable cause of death) get reported as a table with 51 data elements! The other data elements name, Id, village of residence and place of death are primarily useful to prevent duplication. Where there are no software to compute data from line list, the 51 data elements format should be manually calculated.

When aggregating, the most important caution is to prevent errors in addition of corresponding cells and the problem of duplication. Preventing and removing duplication requires that a death reported from one facility should not be also reported from another facility or by the ANM. Primacy of reporting is always given to where the person died. If at home, or on the way to a facility the ANM report is primary. Between facilities, where she is seen last is the reporting unit.

The screen shot below shows how the application allows entry of a line list. And the table shows the format that has to be filled up if a software facility for converting line listing into the table is not available. When HMIS was starting up, there was a lot of resistance to computerization of line-listing,

Box 1D The line list format and the data table

Linelisting: Deaths



Mortality details					
Details of deaths reported during the month with probable causes:					M17
Infant deaths within 24 hrs of birth					17.1
Infant deaths up to 4 weeks by cause	Up to 1 Week of Birth		Between 1 week & 4 weeks of birth	Total	17.2
Sepsis					17.2.1
Asphyxia					17.2.2
LBW					17.2.3
Others					17.2.4
Infant/Child Deaths up to 5 years by cause	Between 1 month and 11 months		Between 1 year & 5 years	Total	17.3
Pneumonia					17.3.1
Diarrhoea					17.3.2
Fever related					17.3.3
Measles					17.3.4
Others					17.3.5
Adolescent/Adult deaths by cause	6-14 yrs	15-55 yrs	>55 yrs	Total	17.4
Diarrhoeal diseases					17.4.01
Tuberculosis					17.4.02
Respiratory diseases including infections (other than TB)					17.4.03
Malaria					17.4.04
Other fever related					17.4.05
HIV/AIDS					17.4.06
Heart disease/Hypertension related					17.4.07
Neurological disease including strokes					17.4.08
Mortality details					
Trauma/Accidents/Burn cases					17.4.10
Suicide					17.4.11
Animal bites and stings					17.4.12
Other Diseases					17.4.13
Known Acute Disease					17.4.13 (a)
Known Chronic Disease					17.4.13 (b)
Causes not known					17.4.13 (c)
Maternal					17.4.09
Abortion					17.4.09 (a)
Obstructed/prolonged labour					17.4.09 (b)
Severe hypertesnion/fits					17.4.09 (c)
Bleeding					17.4.09 (d)
High fever					17.4.09 (e)
Other Causes (including causes not known)					17.4.09 (f)

but with the much larger name-based tracking taken up, generating the table from the line list is now routine – but it is not used for death reporting.

Immediate Actions:

a. Insist on line reporting of deaths- whether or not there is an application that can convert line list into aggregated data. If the latter is not there the service provider has to provide both- for without the line list - duplication

Line listing of deaths reporting helps to prevent duplication in reporting and cross check community based reports sent by ANMs with reports from higher facilities

cannot be avoided. This helps prevent duplication in reporting and helps cross check community based reports sent by ANMs with reports from higher facilities.

b. Insist on area reporting of deaths by ANMs- with place of death being included in the line list information.

c. Check for completion of mortality reporting. Take action on those blocks and districts not reporting deaths. Any block or district not reporting deaths must be visited by an external agency and if unreported deaths are found- action should be taken - including disciplinary action if non reporting of child and maternal deaths is deliberate- for example deaths occurring in the hospitals. Non-reporting of deaths should attract stern action at this stage of the programme, whereas reports of deaths, even maternal and child deaths should be reviewed but not usually subject to disciplinary action.

Intermediate Action:

a. Ensure a proper support application/software is in place where line lists of deaths can be entered at the block level or even at PHC level and mortality reports and analysis is generated electronically.

b. Feedback the mortality information to communities to detect unreported deaths and add it in.

c. Compare block and district level deaths reported with compulsory registrar of births and deaths and correct the missing information in either source.

Long term Action: Complete and compulsory registration of births and deaths - computerized and data shared/triangulated with reports from the health system.

Note: We note that the reporting of live births was also to be a similar line list- but one which also specified place/attendance at delivery, type of delivery (normal, complicated or C-section) newborn weight (taken or not, and birth weight or not), time of breastfeeding initiation. It was understood that this would take longer to establish. With the push to name based tracking, this original design of a simple line list with limited data elements was overtaken, by a much more elaborate form of line listing. Where name based tracking is not in the immediate agenda, there is a case for taking this up.

13. Wrong denominators

Though not strictly data errors, but as use of inappropriate denominators could also lead to decreased reliability and usability of data, this is discussed along with data quality. Common examples of wrong denominators are:

a. Mid-year population for the current year is not estimated correctly, with adjustment for population growth, thus underestimating over estimating the denominator.

b. A significant part of the facilities in that area- and population in that area – is not reported upon. Examples are or company townships, corporations, mining settlements etc. However when calculating the denominator, this population is included.

c. A significant part of the population is seeking treatment in a hospital (often medical college hospital or district hospital or other private sector

hospital) of a neighboring block. When we do a block wise analysis, some blocks would wrongly show poor performance. But when we do the district analysis the denominator would match. The same can be said for inter-district movement for health care seeking also.

Solutions:

a. Interpret locally- at block and district level keeping this problem in mind and adjusting denominators for it.
b. Ask districts and blocks to report as indicators additionally to reporting data elements. Specify the denominators to be used at each level. Ideally all data elements should be reported as indicators.

14. Poor indicators

Some indicators are inherently unreliable. They cannot be relied on because either they are not very precise, or not very specific or not very sensitive or reproducible or measurable. This is discussed in a later chapter.

15. False reporting and falsification

Poor data quality is often attributed to false reporting by service providers. The extent of this problem is over estimated. However it exists. Threats of disciplinary action for poor performance increases its likelihoods. False reporting is more likely for highly monitored indicators and less likely to affect poorly revewied indicators. There are some indicators that attract false reporting more often. With good interpretation many of these problems can be removed and considerable use can be made of the data. However falsification of data at higher levels or pressures from higher levels to falsify data to meet with targets is a much bigger problem – and much more difficult to manage. Greater granularity of data – by encouraging reporting with names, by facility etc offers very little protection against false reporting and none at all against falsification.

False reporting is more likely for highly monitored indicators and less likely to affect poorly revewied indicators

Immediate Action:

a. Improve the competence and sincerity with which programme review are done. Seek to identify the problem behind poor performance of service providers and offer support instead of merely disciplinary action.
b. Train programme managers to study data patterns to extract meaning from the existing data set. Discourage a blame – game around data quality and break the vicious cycle of non-use leading to poor data quality.
c. Annually or once in 6 months conduct a sample survey on recorded data and reported data, as well as on data received and data uploaded at each level. This could be used to measure and reward 'truth telling'. (see tools at end of lesson)

Greater granularity of data – by encouraging reporting with names, by facility etc offers very little protection against false reporting and none at all against falsification

Long term Action:

a. Build a system meant primarily for use of data for local programme management – with some indicators being transmitted to higher levels as a co-lateral gain. Systems built for one's own use are far less likely to be falsified. Allow the system to evolve and develop greater granularity (details) based on increasing participation of its users.

b. Allow multiple data sources and information flows while imposing standards of inter-operability, sharing of data and triangulation. A single final version of the truths is always a temptation to control falsification.

This is discussed further in the seventh chapter.

Trouble-Shooting Data Quality Issues

How do we go about improving data quality in a district HMIS?

1. The first step is to make an assessment of the district HMIS quality causes using the "District HMIS Assessment Form" given in the end of this chapter.
2. Secondly read the analysed and presented final report of the district information system. Systematic analysis of reported data and efforts to use this by programme managers is itself, the most effective tool to assess data quality. Compare this with external survey data where such data is available. Find out which data elements are likely to be wrong or poor quality reports. Discuss with programme managers which data elements and indicators they find as most unreliable or wrong. Which are the necessarily non zero data elements which are reported as zero. Which data elements are failing validation checks repeatedly? Which indicators are unbelievably high, and which are too low. Work out the possible causes for these errors.
3. Make a visit to facilities, block and district HMIS office to both fill the district HMIS assessment form and to trace the causes behind the unreliable or wrong data elements and indicators.
4. Then based on causes identified one should plan remedial action. Such action will often take one of five forms, often a combination of these five:
    a. Training/sensitizing those reporting or entering data
    b. Proper support and supervision to implement corrections needed
    c. An enabling order issued by the district authority

d. An enabling order or guideline issued by state authority

e. Improvement or re-design of the primary registers.

Review Questions

Q.1. What are the dimensions of data quality? What are the two different types of incomplete reporting?

Q.2. This chapter lists fourteen different sources of poor data quality. Could you list these 14 in order of importance for your district?

Q.3. List the data elements which are typically reported as zero in your monthly report. Give examples where the zero is definitely due to failure to report and where it is likely due to be non availability or non utilization of the service and where the zero has a positive meaning- in that a looked for health event did not happen. What are the ways to reduce this zero confusion?

Q.4. One common response for poor data quality is to ask for training the service providers who are recording and reporting data. Which of these 14 sources of error would be reduced by good training of service providers? Would you agree that lack of training to service providers or data entry operators is the main reason for poor quality of information on HMIS?

Q.5. Enumerate the means to reduce data entry errors.

Q.6. Often districts ask to correct the reports they have submitted? What are the most common reasons for such errors? What is the protocol in place to allow for corrections? How would you modify the error management protocol so that the reliability of data on HMIS is improved?

Q.7. Describe the causes of data duplication and ways to reduce it.

Q.8. In popular perception logistic problems (lack of adequate staff and lack of computers and connectivity) and false reporting are the most common reasons for poor data quality. How would one assess the extent logistic problems or false reporting are contributing to data quality in a given district? In this lesson's perspective- false reporting by peripheral service providers has only a minor role to play. Would you agree?

Q. 9. Why is mortality reporting so poor? Discuss the reasons for this… other than a willful failure of service providers to report/lack of motivation?

Q.10. Death reporting and birth reporting were to be done as line listing and then converted into tables. Who and where does this conversion happen? How successful is this strategy? What are the problems in doing this in your district?

District HMIS Assessment Form – Tool for Improving Data Quality

Name of District: No. of Blocks

Section 1: Completion of reporting

		Nos. Present	Nos. Reporting Regularly*	Reporting but Irregularly	Not Reporting	% Reporting Regularly
		(i)	(ii)	(iii)	(iv)	(v)
A0	Blocks					
A1	District Hospitals					
A2	SDH					
A3	CHCs					
A4	PHCs					
A5	SCs					
A6	Number of Other Govt Hospital: ESI/AYUSH/Medical College/public sector					
A7	Number of Private Hospitals accredited or in partnership mode					
A8	No. of Private Hospitals – Non-accredited					
A9	Total Reporting Units - excluding A8					
A10	Total Reporting Units - including A8					

Instructions:

1. Try to collect information on all health facilities exist in the district.
2. Identify how many facilities are regular reporting, irregular & not reporting (regularly 11 or 12 monthly reports, irregularly 6 to 12 monthly reports, less than 6 reports –mark as not reporting.
3. For calculating percent reporting regularly, use column (i) as denominator & column (ii) as numerator and multiply with 100.

Score: Score using row A9. Based on percentage in column-v give 1 mark for each 10 percent.

Note: Software should be customised to generate this report automatically for every month and revise it as and when needed.

Section 2: Timeliness and adequacy of reporting

		Nos. reporting regularly	Nos. Reporting timely*	Delayed reporting	% Timely reporting	No. of facilities reported over 80% on essential data elements	No. of facilities reported b/w 50-80% on essential data elements	No. of facilities reported less than 50% on essential data elements	% of facilities reporting over 80% on essential data element
		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
0	Blocks aggregated report								
1	District Hospitals								
2	SDH								
3	CHCs								
4	PHCs								
5	SCs								
B6	No of Other Govt Hospital: ESI/AYUSH/ Medical College/ public sector								
B7	No of Private Hospitals accredited in partnership mode								
B8	No of Pvt Hospitals – Non accredited								
B9	Total Reporting Units-excluding B8								
B10	Total Reporting Units-including B8								

Instructions:

1. Column (i) values will be same as Section-1 column (ii) values.
2. Timeliness reporting could be within one/two week of reporting date (if there is no systems of capturing information take a sample of forms and see, and even if this is not possible give zero). Delayed reporting could be report received after one of due date.
3. For calculating percent Timely reporting (Column-iv), use column-(ii) as numerator & column-(I) as denominator and multiply with 100.
4. For filling-up of column (v-vii), identify those data elements which are necessarily to be reported as non zero by the district- and by each facility. Within these choose those data elements which are important for program management. (Such as ANC, delivery, immunisation & family planning). From these data elements only identify how much reporting is being done and divide all facilities into three categories-more than 80 percent reporting, 50-80 percent reporting & less than 50 percent reporting.

Score: Score based on B9. For timeliness (column-iv) give 0.5 mark for each 10 percent and 1 mark for each 10 percent in essential data element reporting (Column viii).

Note: Software should be customised to generate this report automatically for every month and revise it as and when needed.

Number of data elements per facility and in aggregates that failed validation tests could also be generated and included as a column in this.

Section 3: Assessing **errors in reporting and falsification (the truth - telling index) gaps between recorded and reported** data

C1	Compare data value of these data elements in District records & Block reports- for last month for which report is uploaded	District record as uploaded	Sum of block reports + DH report as received at District	Block – Report As submitted- 2 blocks	Sum of facilities reports as received in block- 2 blocks	Sample Facility report as sent- 10 facilities	Facility report as seen in records- 10 facilities
		A1	A2	B1	B2	F1	F2
1	DPT3						
2	Measles immunization						
3	Institutional deliveries						
4	3 ANC						
5	Newborn weight at birth						
6	OPD						
7	IPD						
8	Hb test						
9	HIV test						
10	Severe anemia in pregnancy treated						
11	Obstetric Complications						
12	Home deliveries – SBA						
13	Female sterilizations						
14	NSV						
15	Major operation						
	Maximum Score		5		5		15

Instructions:

1. To compare A1 with A2 and B1, B1 with B2 and F1, F1 with F2- 10 percent mismatch is permissible. If variance is less than 10 percent write C- concordant. If variation between A1 and A2 etc is over this- state whether the reported figure is higher or lower (+ NC or – NC- non concordant) than recorded figure. Keep the actual scores in a separate sheet. In separate sheets we would each individual facility sampled and then only put the totals along with C or NC in the column F2. Check at least 2 blocks and 10 facilities in the two blocks taken together (2-CHC, 3-PHC, 5-SC). Also check DH reported data with recorded data.
2. Choose either above given data elements or those which are reported as non zero by over 70 percent of the facilities which provide that service and where other systemic factors like data definition problems that interfere with data quality are not playing a major role. This is to measure truth telling.
3. If the values are same across district & block, compare values of CHC, PHC, SC last month reports with their records and use this as truth telling index.
4. One could also add another column and check the data in F2 with household visits. But this is difficult to do and not recommended. Usually not needed.

Score: In A1 & A2 for each 3 C give 1 mark. In B1& B2 for each 3C give 1 mark. In F1 & F2 for each C give one mark.

Section 4: Institutional HMIS capacity – HR & infrastructure & skills & organisation

1. HR status in position (in numbers): those assigned work of making and submitting the report						
		Nos. Required on full time basis	Nos required on part time basis	Available on full time basis	Available on part time basis	No of RUs not reporting due to lack of this HR
		(i)	(ii)	(iii)	(iv)	(v)
D1	District HQ data entry operator					
D2	DH Hospital					
D3	Block HMIS HQ (block Data Entry Operators)					
D4	SDH					
D5	Other govt hospitals/ facilities where relevant					

Instructions:

1. In district HMIS HQ we mandatorily need a full time data entry person. In block level where all facility level data is to be entered and where pregnancy and immunization data is to be entered we mandatorily need a full time person. In all the rest a part time person would do- but we have to see whether there is someone clearly assigned the task.
2. Usually data entry doesn't happen in the PHCs & CHCs, if there is provision for such a facility exists, please mark this as separately.

Score: Start with 5 marks, cut half mark for each HR unavailable & reporting can't be done.

2. IT Infrastructure						
		Computers Required	Computers Available	% Computers available against required	Internet connectivity	% available with internet
		(i)	(ii)	(iii)	(iv)	(v)
E1	Dist. HMIS officer					
E2	Block HMIS officer					
3	At DH/SDH					
E4	At CHC					
5	At PHC					
6	Total					

Instructions:

1. Fill up the computers required column, as specific for the state- e.g. 2 per district HMIS office or whatever else has been planned by state.

Score: Score using E6 and give half mark for each 10 percent for both computer & internet.

3. Training (skill building)				
	Participants (Designation)	Number of Trainees required	Nos. trained (with days per trainee)	Numbers certified
		(i)	(ii)	(iii)
F1	Service Providers on HMIS reporting (2 days)			
F2	Programme Managers on HMIS (4 days)			
F3	Full time HMIS/Data entry operators on HMIS (6 days)			
F4	Part time HMIS/Data entry operators on HMIS (6 days)			
F5	HMIS Manuals available for reference in every block	Yes/No/in part- give details…		

Instructions:

1. Number of trainees required (column-i) is total number of trainees identified to be trained.
2. Where certification is not introduced – write down the specified no of days agreed with state as essential for building skills. NHSRC is recommendation is 2 days for Manual 1, 2 days for volume 2 and 2 days for volume 3. Leading to evaluation and based on evaluation scores- certification.

Score: For 0-25 percent give half mark, 25-50 percent -1 mark, 50-75 percent 1.5 mark & above 75 percent give 2 mark.

4. Organisation and flow of information		
	Process	Comment
G1	Is there clarity on who (who all) authorizes the data for upload at district level - check for data elements of different programmes.	Officially notified/Not notified -Working/Not working
G2	Is there clarity on who (who all) authorize data for upload at block level	Officially notified/Not notified -Working/Not working
G3	Is there a district level team to review data and read it for use	Officially notified/Not notified -Working/Not working
G4	Is there a block level team to review data and read it for use	Officially notified/Not notified -Working/Not working
G5	Is there clarity on who receives data from facilities- and manually aggregates it to generate the up-loadable block level report	Officially notified/Not notified -Working/Not working
G6	Are there reporting units which are getting left out from aggregation– due to delay or non reporting	Yes/No/Don't Know
G7	Are there protocols/guidelines for error management	Officially notified/Not notified – Working/not working adequately
G8	Are Validation checks run to assess data entry errors? What percent of facilities are not running these checks?	
G9	Is there a feedback form in place for all levels	
G10	Is regular feedback Form sent from district to block	
G11	Is there a regular feedback Form sent to facilities?	

4. Organisation and flow of information		
	Process	Comment
G12	Does the Block office properly maintains copy of reports received & reports send	Yes/No- give details: "Properly maintains" means should have at least 10 months records out of last 12 months
G13	Does the District office properly maintains copy of reports received & reports send	Yes/No- give details. Properly maintains means should have at least 10 months records out of last 12 months
G14	In sub-center level: Is it area reporting in key FP, maternal health and immunization data elements or is it service reporting	
G15	In PHC and CHC reporting is it only facility based reporting or is aggregate of PHC data with sub-centers reported as the facilities' data	
Comments: Look for Government Order which says HMIS teams have been formed in District. **Score:** If officially notified and or working give one mark. If only done in part give half a mark.		

Section-5: Primary register review

H1	Name of data elements missing or can't be computed from ANM registers into SC reporting form	1. 2. 3. 4. 5. Use Separate sheet if more
H2	Name of data elements missing or can't be computed from PHC registers/record to PHC reporting form	1. 2. 3. 4. 5. Use Separate sheet if more
H3	Number of data elements missing or can't be computed from CHC/other hospital registers/records to CHC reporting form or in hospitals	1. 2. 3. 4. 5. Use Separate sheet if more
H4	For Sub-centre registers- are the registers friendly for a. Tracking/follow -up function b. Recording services as and when given c. For carrying to the field when going for service delivery d. Computing the monthly totals for reporting purposes	
Comments if any: Also identify if any data element is there in registers but does not get reported monthly in HMIS forms due to any reason. **Score-** If more than 5 data elements missing give 1 marks & if less than 5 data elements missing give 2 mark for H1-H3. For H4-one mark for each sub-question if found adequate.		

Listing of data elements that are frequently reported wrogly based on type of error (preliminary to filling up the HMIS data quality assessment format)		
Type of errors	What to report	List the possible causes
1. Zero Errors	percent of Essential data elements- which are reported as zero: From all blocks/facilities: From some blocks and facilities.	
2. Recurrent violation of validation rules	List Data elements that are clearly violating validation rules over a number of reporting units and over a number of months.	
3. Persistently low data reading- as compared to expectation	These do not violate data validation rules- but they are still unexpectedly low. Often due to zero reports from a large number of facilities. Or one of many other possible causes.	
4. Persistently high data- as compared to expectation	These do not violate data validation rules- but they are still unexpectedly high. Often due to duplication from a large number of facilities. Or one of many other possible causes.	
5. Random- fluctuations in data element over the months	These could be due to error correction without protocols. Or it could be due to guess reporting of unrecorded data. Or due to poor data definition and inherently poorly measurable data elements.	
6. Mortality reports- under-reports	Most often due to fear of adverse reaction/disciplinary action from higher authorities. Often higher authorities- indicate "not to give unpleasant news" and rock the boat.	
7. High disease incidence or mortality reports	These need to be taken seriously- but poor data definitions, cumulative reporting of a number of months data could cause this.	

Scoring sheet - for district HMIS assessment

Section	Heading	Maximum marks	Marks obtained
Section-1	**Completion of reporting.**	10	
Section-2	**Timeliness and Adequacy of data reporting.**		
1	Timeliness	5	
2	Adequacy of reporting	10	
Section-3	**Truth Telling Index- The gap between recorded data and reported data.**		
1	District-Block concordance	5	
2	Block-Facility concordance	5	
3	Facility-report & record concordance	15	
Section-4	**Components of capacity building**		
1	HR Status	5	
2	Computers	5	
3	Internet connectivity	5	
4	Training and skills – competencies	10	
5	HMIS Institutional Arrangements and Flow of Information	15	
Section-5	**Primary registers data element mismatch**	10	
	Total	**100**	

2 Primary Registers

This chapter explains:

a. The functions that a primary register needs to fulfil.
b. The problems of existing primary registers.
c. The principles of designing primary registers.
d. Some model primary registers for reference.

Introduction

Under the broad framework of Health Management Information Systems, use of concise and succinct data collection tools is critical for improving data quality. Primary registers have always been maintained by the public health system – since its inception. As and when vertical programs increase, numbers of primary registers increase.

Several attempts have been made to improve primary data collection tools, in India and aboard. Though this task appears trivial, most states do not have a satisfactory set of primary registers in place. Part of the problem is that often the administrator underestimates the experience required and not changes are ordered without any field testing or even consultations. Practitioners with considerable experience, who are constantly iterating towards better registers, have never theorized the problems they faced or evolved principles on which to tackle the problem… while it is too trivial or 'operational' for those who usually work with theory.

Under NRHM (since Oct., 2008) the focus has been on building software solutions, and development/editing of primary registers has been considered too mundane a task. There is also the problem of multiple registers for each service provider to maintain. These could be as high as 20 to 30 in many states. Often there is more than one register for the same data. Despite maintaining so many registers often the key functions required of a

Record or primary register is a document of transaction between a client service – user and service provider containing details of who did what to whom, where and when

Number of registers at sub-centre varies from 20-30 in few states

primary register – computing the monthly totals of required data elements, maintaining a record of services delivered and enabling follow up care for the individual patient- are seldom achieved by available registers on the ground.

In this chapter we will define the objectives of primary registers, and discuss their usual shortcomings and measures to rationalize primary registers. The scope is restricted to review of registers that are used for reporting monthly HMIS data from SC, PHC, and CHC & Hospitals.

The 'Maternal health register' and the 'Child immunization register' are the backbone of our RCH program and this chapter will primarily focus on these two registers- as examples of the principles we discuss.

This chapter establishes principles of design of primary registers. It is not recommending a standard register.

Table 1: Registers to be maintained by ANM in a sub-centre as per IPHS and CNAA

S. No.	SC registers as per CNAA 2000	SC registers as per IPHS 2006
1	Sub centre and village information register	Eligible Couple Register including Contraception
2	Household information register	Maternal and Child Health Register: 1. Antenatal, intra-natal, postnatal 2. Under-five register: i. Immunisation ii. Growth monitoring 3. **Above Five Child immunization*** 4. **Number of HIV/STI screening and referral***
3	Eligible couple and children information register	Births and Deaths Register
4	Family welfare services register	Drug Register
5	Maternal care services register	Equipment Furniture and other accessories Register
6	Child care and immunization services	Communicable diseases/Epidemic Register/ ***Register for Syndromic Surveillance****
7	Tuberculosis and Leprosy control	Passive surveillance register for malaria cases
8	Malaria and blood smear and treatment register	Register for records pertaining to Janani Suraksha Yojana
9	Home visit diary	Register for maintenance of accounts including untied funds.
10	Clinic register	Register for water quality and sanitation
11	Stock and issue register	Minor ailments Register
12	Vital events – births	Records/registers as per various National Health Programme guidelines (NLEP, RNTCP, NVBDCP, etc.)
13	Vital events – deaths	

* Marked registers are updated register list in IPHS standards revised draft 2010

Purpose of Primary Registers

There are three main objectives of most primary registers in the public health system. These can be listed as follows:

1. **Record the services delivered** - Also record key health events- birth, deaths, specific disease incidences, etc. This we shall refer to as the service delivery recording function.
2. **Enable follow up of users** - so that the service user can get all the components of care with desired quality. This could be referred to as the tracking function. (It would also be the medical record of the patient)
3. **Enable computation of a monthly report** by aggregating the numbers of different health events and health service delivery events- the reporting function. Such aggregation also is the first step in analysis of the health events and service delivery recorded to improve public health and facility management at the local level.

Three objectives of primary system:

- Record the services delivered
- Enable follow up of users
- Enable computation of monthly report

For example: Recording enables an ANM to know how many children she gave immunization on that day. This is useful for her to have objective evidence for the work she has done, as well as to know how much supplies of vaccine she has consumed or that she needs for the next month. But next month when the children come again, she must know what vaccine she has already given the child and what is the next dose due. This is the follow-up or tracking function. Then when she reports the aggregate number she knows what part of the expected or potential clientiele she has actually reached out to, and how many children have missed their vaccine doses. This she analyses to see who is unable to access her services and why. At the district level, the aggregate figures help the district manager to understand whether the programme is reaching to all those for whom it is intended, and the support that the service provider needs in terms of supplies, or assistance of any sort.

The problem of register design is the problem of how each register achieves these three objectives.

1. Recording function: record of service delivery function and health events

As and when a client/beneficiary receive service, the service provider records the transaction. This record of the "service delivered" which is made as and when it is delivered- is what we call the service delivery recording function.

For an ANM it includes immunization given, antenatal care and post natal care provided, illness care provided to sick children or adults, contraceptive services, counseling of different sorts, laboratory tests done (haemoglobin, urine), fever cases for which slides were made, meetings held and reports of disease outbreaks, adverse effects of immunization, or contraception,

meetings with ASHA, follow up of TB cases, etc. In the usual VHND she may see about 30 persons across all these categories of service in any order, and it is most convenient that she line lists all this in one notebook and then later transfers it into appropriate tracking/disease specific register.

Often states have made no official arrangement for such service delivery recording. So the ANM enters the details in a notebook or unofficial diary and then, when she is back in her office, enters those unofficial diary details into a number of registers. It is quite impossible for the ANM to carry with her the entire set of registers, and therefore also she chooses to take a single "rough" notebook along.

As the system attention is always focused on monitoring and accountability, and not on helping service provider, designing a service delivery recording tool receives a very low priority

The problem with the informal service delivery noting is that there are many columns of data which are forgotten. These are then recalled from memory when she is entering it into the main register. Also if at the end of each outreach session she has to note the number of vaccine vials opened, the number of which was used, the number of sick children she treated etc, the tracking registers are of no use. She needs the line list of services delivered. These problems could be solved if the service delivery diary is more structured- but as the system attention is always focused on monitoring and accountability, and not helping her, designing a service delivery recording tool receives a very low priority.

In the hospital, service delivery records face a different problem. The doctor or nurse - enters relevant details into the case sheet or OP slip in the case of OP patient and into the bed-head tickets in the case of the in-patient. Those who manage registers are usually clerical support staff and the registers they maintain have usually records of the registration and discharge and one or two other "major events" - but do not have many details from the case sheets or medical records. However such data are essential to understand quality of care and outcomes, and for reporting on HMIS. Thus number of pregnant women registered is easy to access, but the numbers who have complications, the numbers given oxytocin or treated for severe anemia are not present in the registers. That information is available only in the bed-head tickets or case sheet. The solution lies in ensuring a register in each ward, and ensuring that at discharge the relevant details as needed for the HMIS are recorded into columns introduced for this purpose. Trying to enter all details into register columns leads to absurdities like 163 columns of data for a single patient!! Some states are getting into such a mess- and the time spent on data entry, may exceed the time spent on patient care. Such "tracking" data has to be available in case records, and only a limited set of data used regularly for casting indicators should be in the service delivery register. District and block hospitals usually handle as much as 50 to 80 percent of all out-patient and in-patient care- and deserve more attention in register design, if we have to get quality data into HMIS.

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Computerization of primary registers has been considered as a solution. Ideally it is service delivery registers which should be computerized with

tracking registers, electronic case records and for HMIS aggregated figures being generated electronically. But this is some distance into the future, not because it is technically impossible, but because it is difficult to get the IT expert/Statistician/ administrator community to understand the logic of clinical case management, and the public health/clinical service provider community to understand the logic of informatics.

2. Tracking function: enabling follow-up and quality of care

Most 'Maternal health register' and 'Child immunization registers' are designed as tracking registers. Tracking regisers are also used in disease control programme where patients have to come for regular follow up. A general set of principles could be as follows:

a. The individual is registered - which means a record is made of name, age, sex, identity by way of address and/or spouse name or head of household name.

b. An unique identity number is desirable.

c. Typically one name is entered in each row. The identity particulars of that individual are entered in the same row in successive columns.

d. Then the services provided and any relevant clinical findings or procedure undertaken during service provision for each individual are entered in successive columns in the same row.

e. There should be a way of knowing the date of the service provision or the record of any clinical finding.

f. One separate column is ideally given for each service/event that needs to be totaled separately. Other findings that are not totaled but needed for reference during a follow up visit could be in the register in the same column- meaning two or three events in a single column- as a way of limiting the number of columns we have and making the register less unwieldy.

   One other principle would be that if the number of data elements being recorded for a single patient exceeds, say 40- or the number of columns that can be accommodated in a maximum of two pages- it would no longer be useful to have more columns stretching over a large number of pages. It may be better to create a case-sheet (or electronic medical record) for each patient/ service user. When the user comes for a follow up one draws the corresponding case sheet, updates the sheet and puts it back. The patient and service provider need only the case sheet number or unique identification number to retrieve, use and update the corresponding case sheet.

   In facility based services, use of case sheets presents a lessor problem- than its use in outreach services, as it is not possible to move case sheets along- or for that matter a bulky set of registers.

Box 2A Problems of computing data element for the monthly report examples

a. Data element: Women receiving post partum checkup within 48 hours & between 48 hours to 14 days.

Problem: Delivery & PNC registers are separate. PNC registers record only the date of PNC visit and not the date of delivery. In such instances it becomes difficult to compute whether this visit was made within 48 hours or after 48 hours.

b. Data elements: ANC registration in first trimester.

Problem: In primary registers ANM records the date of a woman's last menstrual period and the date when the ANM first met the pregnant woman. At the end of month ANM has to identify from those two dates whether the first visit was in the first trimester or in 2nd or 3rd trimester. ANM needs to do this for each pregnant woman registered during the month and then compile the figure to make a total of first trimester registration. Such tedious computation inevitably leads to errors.

c. Data element: Number of doses of DPT3 given.

Problem: In a tracking register- we record the dose of immunization given against the name of the child. Now if at the end of the month one has to compute the total number of children given say DPT3, the ANM would require to see not only the children who have been given DPT 3, but the date on which it was given as well. That would mean a doubling of columns- but even then it would be difficult to count. In the service delivery record we record the dose of immunization given in each session and we could use this for computing the total doses of DPT3 given much easier- provided there is a service delivery register and provided it gives the space for such computation.

That is one reason why the service delivery recording register needs to be separated from the tracking register in outreach services.

3. Reporting function

To monitor the functioning of healthcare facilities and to allocate supervision and financial support according to needs, each facility reports the number of services provided in a pre-defined reporting form to its reporting facility/ office every month. This monthly report also reports key health events. The data requirements of monitoring are one of the important influences that shape primary registers. Often they could be the only influence, and the needs for the register to be a tool of better service delivery and work organization of the service provider could be ill-understood.

To enable reporting, register design must enable easy and accurate computing of the monthly totals of all data elements

To enable reporting register design must enable easy and accurate computing of the monthly totals of all data elements. This usually requires that at the bottom of each column there is a 'totals' row and further that these totals are recorded in a separate page for monthly totals. In the accompanying box we give some examples of difficulty in computing.

Computerization would make it easier and more accurate to get these totals but then the system would require entry of all the service delivery records. This is best done at the level of the facility itself. Though currently difficult to achieve at the sub-center level, it is much easier to achieve this at PHC and higher levels.

Analysis of data at facility level will help optimize work better and also helps detect data error and improve quality of data. For this it is essential that the software used, provides easy to use analysis and display functions.

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Logistic and Organizational Issues

a. **Lack of clarity on how to differentiate ANM as service provider from that of services provided by others which she has to track.** Coding or separate reporting mechanism is required as it is very important to distinguish & identify these two functions. This will ensure that there is no duplicate reporting.

b. **Beneficiary identification number:** Different beneficiary identification numbers such as serial numbers, eligible couple numbers, numbers from family health register, etc. are used, completely at the discretion of the healthcare worker. Also, interpretation of these numbers is known only to the one who created them or not known at all. When a patient moves between facilities or between divisions in a facility- the id markers – number, name, age, which are used to prevent duplication needs to be standardized- and this is seldom done.

c. **Limited availability of printed registers:** Most registers are hand drawn without any model registers to refer to. Printed registers are often made available but run out of stock and are not replced

d. **Unavailability of standardized registers:** No standard register format is available which addresses data recording and data reporting needs of HMIS at the PHCs and CHC/Hospitals. These facilities do not have clear instructions about maintenance of tracking registers and service delivery register. In absence of such guidelines, the data

entry operator is unable to decipher information available in records/ reports/registers.

e. **Clear instructions for record keeping unavailable**: Healthcare workers are often not provided with clear guidelines or instructions about how to record and maintain data in Primary Registers. This leads to subjective interpretation and erroneous reporting. Clear instructions for the following are critical:

   i. *Data filling instructions:* In the table below it is not clear how the data needs to filled in the space provided (date, Yes/No, sign (*, √), etc.). If a sign or yes/no is used then monthly aggregation becomes difficult since it cannot be deciphered which 'yes' is current month's 'yes' and which 'yes' was previous month's 'yes'. The instruction should be that if it is an 'yes' – to enter the date - not 'Y'.

Box 2B: Example of design problem in primary register

S. No.	ANC Checkup	TT Dose	
		1st Dose	2nd Dose/Booster Dose
1			
2			
3			

   ii. *Instructions for coding of cause of death:* The codes are ambiguous and not clearly explained, e.g., the tables below show codes for complications but one woman can have more than one complication in a given pregnancy. Instructions on how to code multiple complications are not available.

Box 2C

S. No.	Date of delivery	Delivery complications	Outcome of delivery
1			
2			
3			

Delivery complication codes
1. Ante partum hemorrhage
2. Post partum hemorrhage
3. Obstructed labour
4. Eclampsia
5. Puerperal sepsis

Instructions mon reporting a data element only when it has a specific attribute:

iii. *Recording resister design output:* Only newly reported hypertension in a pregnant woman has to be reported. Which means to report it only if high BP is being recorded "for the first time". But as one can see in the example above - it may be recorded in a fashion where this attribute" for the first time" is not apparent.

Box 2D				
S. No.	Name	Visit date	Service given (TT/IFA)	Hypertension
1	A	12/4/11	TT1	Yes
2	B	12/4/11	Booster	No
3	C	12/4/11	30 IFA	No

It is not clear whether case 'A' reported high BP for the first time or second time.

Action Points

Immediate Action: Identify the essential data elements missing in primary registers at each service level and send an instruction to add these columns of data in. Circulate appropriate instructions on primary register maintenance.

Identify the essential data elements missing in primary registers at each service level and send an instruction to add these columns of data in.

For immunization, newborn care and pregnancy at the sub-center level just rationalize and use the same tracking register under the Mother and Child Tracking System.

Intermediate Action: Ensure that the registers are re-designed to provide all three functions- the tracking or the service delivery recording function and the reporting function. Rationalize the register so as to reduce burden of data recording and reporting work.

Ensure that the registers are re-designed to provide all three functions- the tracking or the service delivery recording function and the reporting function.

Long term Action:

a. Bring in hospital information systems for computing the data required from larger hospitals and even CHCs. Open source with no licensing fees solutions are available.

b. Gradually shift to electronic medical/case records as the form of all data entry and build computer system that extract the aggregated data needed from this.

Review Questions

Q.1. What are the three main functions that properly designed primary registers should fulfill? To what extent does the sub-center registers as they currently exist in your district help perform these functions. How are ANMs recording data and the point of care provision?

Q.2. List the primary registers to be maintained by ANM as per the IPHS guideline. What are they currently maintaining in the district?

Q.3. Does the set of primary registers used in the sub-center help in tracking the drop out of immunization cases? What changes in this register would help?

Q.4. Explain the computing problems in primary registers with an example from a sub-center register.

Q.5. List the data elements which are missing from the primary registers of your district sub-center and a PHC. Draft an order to be issued by the chief medical officer to immediately correct these gaps.

Q.6. How are primary registers at sub centre different from recording registers at DH/SDH/CHC?

Q.7. A district hospital may handle as many as one third of all cases seen in the public health system. What is the minimum set of primary registers needed and how is the monthly report finalized from this?

Q.8. Primary registers can easily be designed to capture data disaggregated by caste- but that does not make reporting disaggregated data by caste easier. Discuss.

Q.9. What would be the role of using a unique case sheet number or other form of unique alphanumeric identification for an individual or family. What advantage does it provide? What are the difficulties seen in implementing this?

Q.10. Patient information in a hospital is based on case sheets and on bed-head tickets- and less on registers. What implications does this have for register design and for recording and reporting information?

Q.11. How do logistics and organizational issues put impact on non-availability of standardized registers?

Q.12. Prepare a model standardized register for your district sub-center/ PHC/CHC. Take into account the existing practice and the desired practices.

A model set of primary registers

For the sub-center

A. **Service delivery register - or the ANM diary:** This is the only register for taking along- records services as and when given. Separate sections/pages for recording service delivery for (i) Pregnant women, (ii) Children, (iii) Eligible couples and for (iv) General OPD and all other work. All service delivery is recorded as simple line lists.

B. **Demographic and eligible couple register:** has separate pages for (i) Base line of families and population and eligible couples and captures changes in this during the year, (ii) Also the line listing of births and deaths and (iii) Could have contraceptive usage and needs.

C. **Maternal health register:** this needs to be synergized with the pregnancy tracking register to ensure that the minimum functions as outlined in this can be performed by the latter register. This has three sections or pages- (i) for recording follow up data in the antenatal period, (ii) for pregnancy outcomes and for post partum care including care of the newborn (iii) Computing the monthly report as "service delivery reporting" and if needed also computing the monthly reporting as "area reporting."

D. **Immunisation register:** This needs to be synergized with the child tracking register if that is in place, so that the minimum functions as outlined in this, can be performed with the latter register. This register has three sections- (i) The immunization follows up pages- with one row across two pages for each child and (ii) The immunization session record registers which helps in monthly reporting of service delivery in immunization. (iii) The monthly consolidation report on full immunization achievements.

E. **Labour room register:** this is only for deliveries conducted by the ANM whether at home or at the facility.

For primary health center and all higher facilities

In addition to the above we need the following recording registers:

1. Outpatient register
2. In patient register register – for each ward incuding emergency and ICU wards
3. Institutional delivery Register
4. Laboratory Register.

Five major set of model primary register

- Service delivery register - or the ANM diary
- Demographic and eligible couple register
- Maternal health register
- Immunisation register
- Labour room register

A. Service delivery register - or the ANM diary

Sub-centre information sheet	
One row across 1 page	
Coloumn no.	**Data elements**
1	Village name
2	Name of panchayat
3	Population
4	Distance from sub-centre
5	Name and phone number of AWW
6	Name and phone number of ASHA
7	Date of conducting VHND
8	Any other fixed day

ANM tour sheet	
Coloumn no.	**Data elements**
1	Date
2	Day
3	Task detail
4	Follow-up

Immunization page	
Coloumn no.	**Data elements**
1	Date
2	Name of village
3	Child's name
4	Age
5	Sex
6	Father's name
7	Name of vaccine given
8	Adverse event following immunization

Pregnancy related service provided sheet	
Coloumn no.	**Data elements**
1	Date
2	Village name
3	Mother's name
4	Husband's name
5	Age
6	Services provided a. Weight b. BP c. Hb test d. Urine test e. Foetal heart rate f. Fundal height g. Any complications

Post natal service detail sheet	
Coloumn no.	**Data elements**
1	Date
2	Name of village
3	Women's name
4	Age
5	Date of delivery
6	Husband's name
7	**Services delivered**

OPD page	
Coloumn no.	**Data elements**
1	Date
2	Village name
3	Patient's name
4	Age
5	Sex
6	Father's/husband's name
7	**Provisional diagnosis**
8	**Services delivered**

B. Demographic and eligible couple register

B.1 Baseline register

Baseline register	
Coloumn no.	**Data elements**
1	ID No.
2	House no
3	Name of head of household
4	Caste
5	Religion
6	Whether have BPL card – yes/no
7	No. of members in the family ▪ Male ▪ Female ▪ Total
8	No. of children in the family (0–12 months) ▪ Male ▪ Female
9	No. of children in the family (1-5 yrs) ▪ Male ▪ Female
10	No. of eligible couples in the family
11	No. of Births – date and sex
12	No. of deaths – date and sex
13	Marriages – date and sex
14	Migration – date and sex

Consolidation sheet (annual) at the beginning of the year
Baseline population ▪ Male ▪ Female ▪ Total ▪ Population (religion wise) ▪ Population (BPL/APL)
Baseline population of children (0-12 months) ▪ Male ▪ Female ▪ Total ▪ Population (religion wise) ▪ Population (BPL/APL)
Baseline population of children (1-5yrs) ▪ Male ▪ Female ▪ Total ▪ Population (religion wise) ▪ Population (BPL/APL)
Total no. of eligible couples
Total no. of births this year
Total no. of deaths this year
Population growth due to marriage or migration
Population decline due to marriage or migration
New eligible couples

B.2 Family planning register

Family planning service page	
Coloumn no.	**Data elements**
1	ID No.
2	House no.
3	Eligible couple Name and age of husband and wife
4	No. of living children
5	Age of youngest child
6	Temporary spacing method used IUD Pills Nirodh Emergency contraceptive pill
7	Sterilization date Male Female
8	Beneficiaries wanting to adopt family planning services but services not available
9	Change of family planning method with date

Family planning consolidation sheet	
Coloumn no.	**Data elements**
1	Month
2	Sterilsation done this month ▪ Male ▪ Female
3	Spacing methods used ▪ Nirodh distributed ▪ Pills distributed ▪ IUD inserted ▪ IUD removed ▪ Centchroman pills ▪ Emergency pills
4	Complications due to sterilsation in ▪ Male ▪ Female
5	Sterilization failure ▪ Male ▪ Female

C. Maternal health register

C.1 Pregnancy tracking register

Pregnancy tracking page	
One row across 2 pages per woman- total of about – 16 pages per register	
Coloumn no.	**Data elements**
1	ID no.
2	Name of women
3	Age
4	Husband's name
5	Parity
6	JSY registration date
7	Months on date of pregnancy at the time of registration
8	EDD
9	ANC-1 a. Date b. Fundal height c. weight
10	ANC-2 a. Date b. Fundal height c. weight
11	ANC-3 a. Date b. Fundal height c. weight
12	Complications
13	Where referred – if so.
14	IFA 100 given on date
15	TT`1 given on date
16	TT2 booster given on date

Pregnancy outcomes page	
One row across 2 pages per woman and follow up- total of about – 16 pages per register	
Coloumn no.	**Data elements**
1	ID no.
2	Name of women/Husband's name
3	Village name
4	Date of delivery
5	Place of delivery (home/sub-centre/other)
6	Delivery done by (ANM/LHV/Doctor/TBA/Other)
7	Pregnancy outcome (live birth/still birth/abortion)
8	Type of delivery (normal/complicated/c-section)
9	Sex of the child
10	Weight of new born at birth
11	New born illness treated with
12	Payment under JSY 1. Mother (amount and date) 2. ASHA (amount and date)
13	Post natal care (<48hrs) a. Given – yes/no b. Complications identified c. Complications managed with
14	Post natal care (between 48 hrs-14 days) Given – yes/no Complications identified Complications managed with

C.2 Monthly consolidation page

Pregnancy monthly consolidation page	
One month on each row – 12 rows- each row across two pages. Only two pages	
Coloumn no.	**Data elements**
1	Month
2	Total registered pregnant women
3	Registration in first trimester
4	Total number of women given ANC 1
5	Total number of women given ANC 2
6	Total number of women given ANC 3
7	Total number of women given TT 1
8	Total number of women given TT 2
9	Total number of women given 100 IFA
10	Total number of women having BP > 140/90
11	Total number of women having anaemia (Hb<11gm)

Pregnancy outcomes monthly consolidation page	
One month on each row – 12 rows- each row across two pages. Only two pages.	
Coloumn no.	**Data elements**
1	Month
2	Home delivery by SBA
3	Home delivery by non SBA
4	Total no. of home delivery cases paid JSY
5	Total no. of deliveries at sub-centre
6	No. of women discharged within 48hrs of delivery
7	Payment made to mother's
8	Payment made to ASHA
9	Pregnancy outcome – Live birth-(male/female) Still birth Spontaneous abortion
10	No. of new borns weighed
11	No. of new borns having weight < 2.5 kg
12	No. of new borns breast fed within one hour
13	Post natal care given (within 48 hrs) Seen at home Complications (if any)
14	Post natal care given (between 48 hrs & 14 days) ▪ Complications (if any) ▪ Treated with

D. Child immunization register

Immunization (tracking) register (0-2 years)	
Coloumn no.	**Data elements**
1	ID No.
2	Mother/father's name
3	Birth date
4	Sex
5	Immunization dates for 1. BCG 2. DPT1 3. DPT2 4. DPT3 5. OPV1 6. OPV2 7. OPV3 8. HEP B 9. MEASLES 10. VIT A
6	Age at which fully immunized
7	Booster dose date 1. DPT 2. OPV
8	Adverse events following immunization (AEFI) 1. Name of vaccine and batch no. 2. AEFI-abscess/death/others

S.No.	Monthly consolidation sheet
1	Month
2	Fully immunized children (1-11months) ▪ Male ▪ Female
3	Fully immunized children (12-23 months) ▪ Male ▪ Female
4	AEFI ▪ Male ▪ Female

Immunization session register	
Coloumn no.	**Data elements**
1	Date
2	Place
3	Whether ASHA was present
4	Presence of Anganwadi worker/ supervisor
5	Payments made to ASHA
6	No. of opened vials
7	No. of children given BCG
8	No. of opened DPT vials
9	No. of children given DPT
10	▪ DPT 1 ▪ DPT 2 ▪ DPT 3
11	DPT Booster
12	No. of opened OPV vials
13	No. of children given OPV
14	OPV 1 OPV 2 OPV 3
15	OPV booster
16	Other OPV/OPV0/Pulse polio
17	No. of opened measles vials
18	No. of children given measles
19	No. of vitamin A vials opened
20	▪ Vit A 1st dose ▪ Vit A 5th dose ▪ Vit A 9th dose
21	DT 5
22	DT 10
23	DT 16
24	▪ Hep B1 ▪ Hep B2 ▪ Hep B3

E. Labour room register

Eligible couple register	
Coloumn no.	**Data elements**
1	I D no.
2	House no.
3	Woman/husband's name
4	Age
5	Village name
6	Place of delivery Home Sub-centre
7	Date of labor pains when started and time
8	Date of admission
9	Complications
10	Complications treated/referred out
11	Delivery outcome Live birth Still birth
12	If live birth Sex of child Weight of child
13	Whether Breastfeed within 1 hr
14	Date of discharge
15	PNC given in case of complications
16	Treatment given
17	JSY benefit given or not

3 Crafting and Validating Indicators

In this chapter you will learn about the:

a. The process of developing indicators to monitor a programme.
b. The technical attributes of an indicator.
c. The process of validating and categorizing indicators for use in a programme- based on their attributes.
d. How to write down the properties of an indicator so that it could be used better by programme managers.

Introduction

With the increasing emphasis on monitoring and evaluation of programmes, there has been a proliferation of indicators. Most of these indicators lack harmonization among them. This leads to increased reporting burdens at various levels without actually enabling the programme managers to manage programmes effectively. Many indicators are never used. Some could be misleading and inherently Crafting and validating indicators is therefore at the heart of the whole process of monitoring- and perhaps one of the most important skills required for design.

But first let us recall the difference between a data element and an indicator, and why we need indicators at all.

Data element is only a recorded event- like a service delivered or a disease occurrence. It has public health meaning only when that event is placed in a context where it gives meaning about the performance of a programme that is being monitored. To derive such meaning, this data element has to be placed in relation to another number, or data element, which tells us about the context. This second number could be the population, or the total expected beneficiaries or a target number of beneficiaries. When a data element representing an activity or event is expressed as a proportion of another data element representing the context- we call it an Indicator.

Crafting and validating indicators is the heart of the whole process of monitoring- and perhaps one of the most important skills required for design

The relationship of a single indicator to the programme is much like watching a football match through a chink in the fence

Indicators are measures of the performance of programme. The relationship of a single indicator to the programme is much like watching a football match through a chink in the fence. But if we add more and more carefully chosen indicators- we can get to see more and more aspects of the programme. Like we have more vantage points to watch the match from. But each indicator carries with a burden of data element collection, reporting, interpretation, not to speak of data quality problems. Hence the art of designing indicators for monitoring a programme is therefore to find a set of indicators which maximize the actionable information gained and minimize the burden of work in gathering them. Or reduce the burden of reporting without losing out on useful information.

This chapter is an effort to acquaint the programme managers of the principles and techniques involved in crafting and validation of indicators. The use of existing indicators is discussed in another chapter. The principles described in this chapter are essential, whenever we need to include a new programme for monitoring under the HMIS. But they are also useful to reflect on existing indicators and data elements and rationalize them further.

Process of Selecting Indicators

Addressing the concern about the proliferation of indicators leading to increased reporting burdens on national data collection systems, WHO proposed a list of steps that should be followed before the indicators are selected for monitoring.

The steps in selecting indicators are:

a. Identification of existing lists of proposed indicators for the programme. Proposing new indicators where there are gaps.

b. Defining the hierarchy of the indicator- who needs it – and for what use – at what level- national and state for policy, district and block for planning and management.

c. Defining the indicator in terms of the logical framework model: Inputs – Process – Outputs – Outcomes – Impact.

Art of designing indicators for monitoring a programme is finding a set of indicators which maximize the actionable information gained and minimize the burden of work in gathering them

d. Evaluation of each indicator using objective criteria of evaluation. These criteria include pragmatism or feasibility- choosing indicators where data sources exist and are reliable, instead of adding new tasks.

e. Field testing the indicators:

   i. Identification of the **'strong'** indicators – performing more adequately when subjected to scrutiny using the criteria.

   ii. Identification of gaps in the coverage of the strong indicators, identification of the least problematic of the **'weak'** indicators proposed for the programme areas – where strong indicators fails to provide a full picture.

f. Review and finalization of the short list by a panel of decision making programme managers, informatics experts and public health domain experts- Negotiation but based on evidence and criteria.

Indicators are succinct measures that aim to describe as much about a system as possible in as few points as possible

Defining Hierarchy of Indicators

Information needs at different levels of program management and planning and policy making are different. Some types of information are more important at a particular level than others. Thus it's imperative to assess data needs at each level and very crucial to understand the purpose served by indicators at different levels.

"Indicators are **succinct** *measures that aim to* **describe** *as much about a system as possible in as few points as possible"*. They will never describe the whole programme and all its processes. Looking at a programme through indicators has been likened to looking at a football match through a chink in the fence. Not the best way to watch a football match, but if this is the only way- choose a well situated chink in the fence!!

Role of indicators at various levels is as follows:

a. **Global level** indicators provide information on levels and trends in international progress on various programs. Indicators at this level inform the international political debate, help donors set priorities, improve coordination and collaboration within the international community, and sensitize public opinion on global development issues. Indicators at this level basically focus on outcome and impact level indicators.

b. **National and state level** indicators measure progress of programs within individual countries. Indicators at this level inform and monitor National policies, help countries set priorities, and help allocate resources for areas where needs are greater. These indicators focus on outcome and impact level indicators and also on some output indicators- to measure the effectiveness of different strategies.

For state and national center to supervise the districts - it is best if they get the information on performance of the districts in the form of indicators rather than in the form of data elements

With the increasing emphasis on monitoring and evaluation of programmes, there has been a proliferation of indicators. Most of these indicators lack harmonization among them. This leads to increased reporting burdens at various levels without actually enabling the programme managers to manage programmes effectively. Many indicators are never used. Some could be misleading and inherently

The way HMIS data is process should be consistent with the objectives for data collection and the plans for data analysis and utilization

c. **District indicators** measure all that is needed for state, national and global levels- as well as all as for improved planning and management at the district and sub-district level and for supervision of facilities and allocation of human and financial resources.

d. **Facility, project level** indicators to provide information relevant for higher levels plus for Improved Management Locally. Process and output indicators needed for increasing efficiency, quality and effectiveness of health service delivery and programme implementation.

When selecting an indicator for a particular level- it is worth asking yourself- what has been done with indicators already available- which were used and which were not. Which indicators were never looked for, even once. Also to challenge the programme manager with the question- what they would do with the information if it was provided.

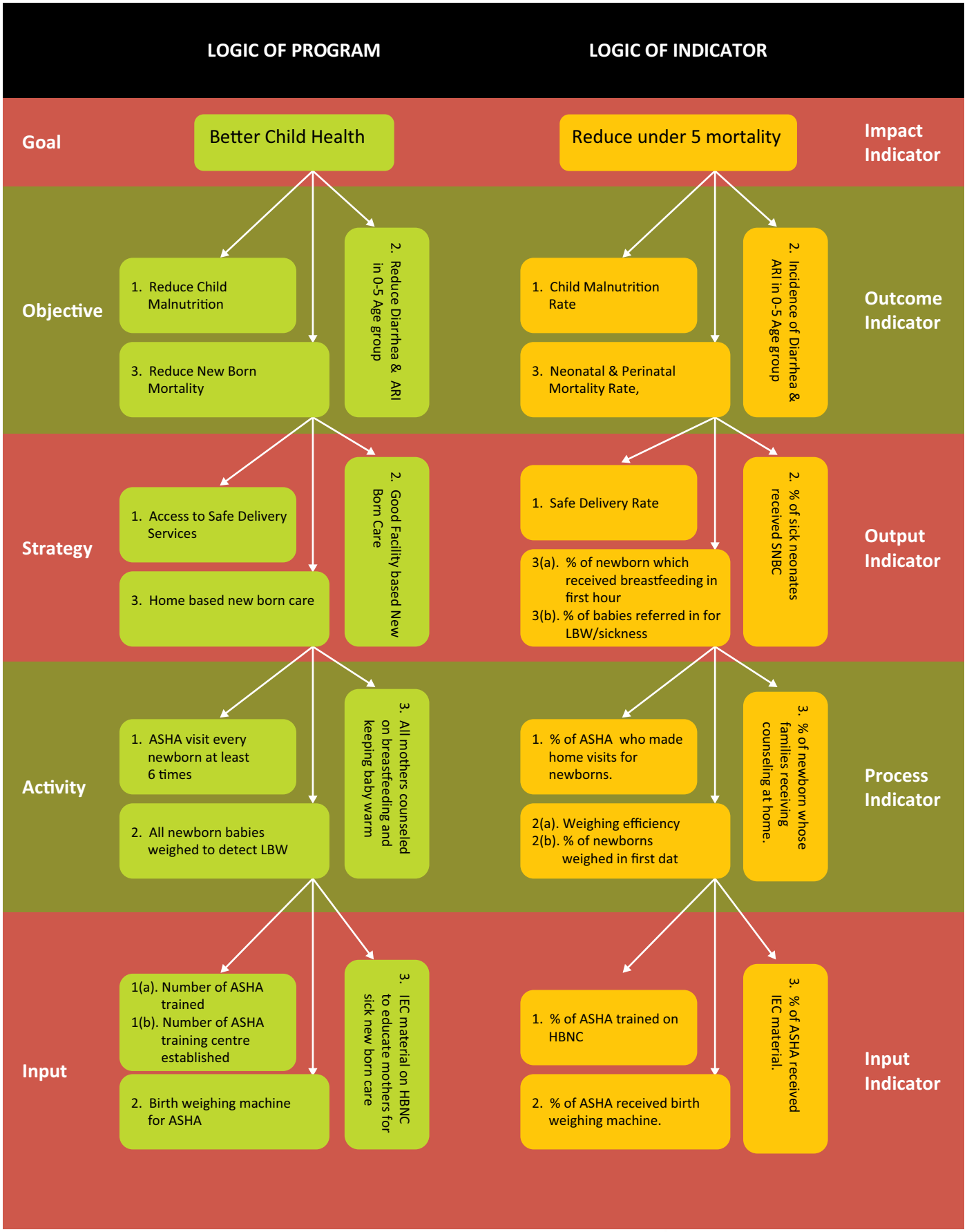
For most policy and planning decisions, it is enough to have a few well chosen indicators- about 10 to 20 indicators in all. Also for policy decisions it is best to use indicators drawn from sample surveys. Routine monthly reporting is best used for management decisions and supervision purposes in the district level. For state and national center to supervise the districts – it is best if they get the information on performance of the districts in the form of indicators- rather than in the form of data elements which they have to compute into indicators. If the latter option is chosen, there would invariably problems of the denominators- which vary widely in a context specific manner.

Defining Indicators on "Logic Model"

Indicators are part of planning, implementation plan as well as monitoring process. The logic is that a programme objective or health outcome (measured by outcome indicators) results from a number of strategies acting together. Output indicators measure the effectiveness of strategies. Strategies in turn are composed of a number of activities or processes (measured by process indicators) which in turn require inputs (measured by input indicators). When monitoring a programme one needs a good mix of indicators at each of these levels and this helps to align various activities and outputs to objectives. Impact is health outcomes over a longer range, the cumulative effects of programs interacting with other developments in society over time. Impact indicators relate to goals and outcomes indicators to objectives. In the achievement of an impact indicator/goal, the programme is only one input amongst many. In the achievement of a outcome indicator, the programme is everything and has to be accountable to achieve this.

We give examples in the diagram in the facing page:

There are no rigid boundaries between the various logical components of this framework, sometimes an indicator or activity can fit more than one category, depending upon how it is viewed.


LOGIC OF PROGRAM
LOGIC OF INDICATOR
Goal
Better Child Health
Reduce under 5 mortality
Impact Indicator
Objective
1. Reduce Child Malnutrition
2. Reduce Diarrhea & ARI in 0-5 Age group
3. Reduce New Born Mortality
1. Child Malnutrition Rate
2. Incidence of Diarrhea & ARI in 0-5 Age group
3. Neonatal & Perinatal Mortality Rate,
Outcome Indicator
Strategy
1. Access to Safe Delivery Services
2. Good Facility based New Born Care
3. Home based new born care
1. Safe Delivery Rate
2. % of sick neonates received SNBC
3(a). % of newborn which received breastfeeding in first hour
3(b). % of babies referred in for LBW/sickness
Output Indicator
Activity
1. ASHA visit every newborn at least 6 times
2. All newborn babies weighed to detect LBW
3. All mothers counseled on breastfeeding and keeping baby warm
1. % of ASHA who made home visits for newborns.
2. % of newborn whose families receiving counseling at home.
2(a). Weighing efficiency
2(b). % of newborns weighed in first dat
Process Indicator
Input
1(a). Number of ASHA trained
1(b). Number of ASHA training centre established
2. Birth weighing machine for ASHA
3. IEC material on HBNC to educate mothers for sick new born care
1. % of ASHA trained on HBNC
2. % of ASHA received birth weighing machine.
3. % of ASHA received IEC material.
Input Indicator

Example 2: Reduction in deaths and disability due to cardiovascular disease

Logical framework-generic	Logical framework – specific	Logical framework for indicators	Specific indicators at each logical level
Goal	1. Improved life expectancy 2. Reduced cost of medical care 3. Improved productivity of workforce	Impact Indicator	▪ Life expectancy ▪ Life expectancy at 50 years ▪ Average per capita cost of medical care- total (public and private)
Objective	1. Decrease in mortality due to strokes and ischemic heart disease 2. Decrease in hospitalization/ loss of mandays due to strokes and ischemic heart disease and hypertension complications	Outcome Indicators	▪ Proportion of deaths due to cardiovascular disease ▪ Proportion of hospitalization on account of IHD, hypertension complications and strokes ▪ Incidence of stroke and heart attacks
Strategies	1. Primary prevention of hypertension 2. Screening of all above 30 for hypertension and managing them such that their BP is well controlled. 3. System of non emergency referral support for starting treatment and managing complications. 4. Emergency response systems and intensive care unit for heart attacks and strokes.	Output Indicator	▪ Percent of above 30 population who have hypertension ▪ Percent of those detected as hypertension who are in regular treatment and whose BP is well controlled ▪ Percent of hypertensives who were referred and seen by specialists for complications ▪ Percent of strokes and acute cardiovascular emergencies whose onset of symptom to start of treatment time was within the norm ▪ Case fatality rate in acute cardiovascular emergencies
Activities (only as related to the second strategy)	1. Screening all those above 30 for hypertension at least once every year – at community/or workplace/opportunistic 2. Monthly check up of every hypertensive once every month- with adjustment of doses and management of complications as needed – at community/ workplace/evening clinic 3. Training of community level health workers to do regular BP measurement and dispense monthly drugs 4. Referral system so that those not controlled or with complications are managed by specialists and then sent back for follow up	Process indicator (only as related to the second strategy)	▪ Percent of adult population screened for hypertension ▪ Percent of hypertensives who are out-of control or whose control status is unknown ▪ Percent of villages/workplaces where there is a trained worker with capacity to screen and dispense drugs ▪ Percent of known hypertensives who were seen at a referral center for a complication
Inputs	Financial resources for programme Technical assistance for programmes	Input Indicator	Percent of budget expended Quality of plans/guidelines

Linking hierarchy of indicators to logical framework

A general principle is that at a block level we need all the data elements required to compute the process indicators and output indicators. This would enable not only to assess performance but detect gaps and therefore supervise the functioning of each facility in considerable detail. The denominators would usually be too small for any outcome measurement.

At the district level we need only those data elements that are required to calculate the all possible output indicators and all outcome indicators. Impact indicators however would not be reliable.

At the state and national level we should avoid collecting any data elements that contribute only to process indicators or even output indicators and should collect only those data elements that contribute to outcome indicators. The focus should be on outcome and impact indicators.

Does that mean we do not need to know about the outputs at the state level? No. We need to know- but we should collect this information as indicators. Thus we would like to know the percent of those screened for hypertension for each district- but not the number of those screened. Or we would like to know district-wise the percent of villages having trained Community Health Workers (CHWs), not the number of CHWs trained in each district. The latter number is difficult to use, especially at greater and greater aggregations. Also by encouraging districts and blocks to report indicators- we get them to see the meaning of their data - without having the national web-portal calculate it and feed it back to them. Not only is it difficult to do the latter because of technical issues, it is impossible - because of contextual factors. Thus in one district a specific value say 50 percent for each of the above examples may represent a successful achievement of the target and in another a very poor performance. This could be because the targets were lower, or because there is a large private sector from which we are not collecting data, or because the others are going to a neighbouring district for treatment etc. This "meaning" would be known at the local level- but these contextual variations would make it impossible to interpret and use the data at the national or even state level (except perhaps in a very small state).

Crafting monitoring programme and indicators for a new programme

When a new programme is launched, it would need a monitoring plan. The basic approach of building a monitoring plan is to develop a logicial framework - of how various inputs are converted by activities to lead to various outputs. These outputs would act together to lead to a outcome, which would have an impact.

Also by encouraging districts and blocks to report indicators- we get them to see the meaning of their data - without having the national web-portal calculate it and feed it back to them. Not only is it difficult to do the latter because of technical issues, it is impossible - because of contextual factors.

The basic approach of building a monitoring plan is to develop a logicial framework - of how various inputs are converted by activities to lead to various outputs. These outputs would act together to lead to a outcome, which would have an impact

If an indicator is to be of value, it is important that the information it generates is needed and the programme manager should be able to indicate what action would be taken if the indicator indicates a value that does not match with the expectation

There is considerable clarity needed on what is the outcome required and how each activity or mechanism that constitutes the programme acts to yield the outcome.

Once this logic of the programme- or programme theory- is clearly defined, one could then choose indicators to measure each of the logical steps- inputs, activities, outputs, outcomes and impact.

The example of logical framework for prevention of mortality and morbidity due cardiovascular diseases as given below is an example of how such a logical framework can be constructed.

Criteria for Selecting/Assessing an Indicator

(Taken from "Indicator Standards: Operational Guidelines for Selecting Indicators for the HIV Response")

A good indicator has a number of attributes given below. Each indicator should ideally be assessed on the following criteria to arrive at a group of indicators which help monitor or evaluate the progress of the programme under study:

I. **Need and usefulness:** If an indicator is to be of value, it is imperative that the information generated by the indicator is desirable and will be of use to programme manager or service provider. For example, the indicator "Met needs of emergency obstetric care" would help understand whether institutional delivery has attained the minimum quality required in terms of management of complications. This could be used for skill development and more focused supervision of facilities or development of referral systems for obstetric emergencies. If an indicator is to be of value, it is important that the information it generates is needed and the programme manager should be able to indicate what action would be taken if the indicator indicates a value that does not match with the expectation. This is obvious enough. However in practice there are other reasons for including indicators:

   a. Often programme managers include an indicator so as to remind the service provider to undertake an action. This will certainly not work where the service provider is not the data provider (as happens in larger facilities) or where there is not the where withal to undertake the activity (skills, equipment etc.). Sometimes it is even used to introduce the programme. A general principle is that the indicator should be put in place only after the programme is rolled out.

   b. One of the most difficult demands of the programme manager is to use the HMIS as a substitute for support and supervision. Thus one may ask for number of adolescents attending clinics.

There would be no way of making sense of the number, because there is no denominator- but in the perception of the programme manager, the service provider would feel watched- and this in itself would improve the programme. Such a programme manager does not even feel compelled to read the data coming in- the very act of being asked to report is expected to improve accountability. Programme manager believe that "If it is not monitored it will not happen." This is true- but inclusion in the HMIS at all levels is not a substitute to the monitoring and supervision needed. Such a data element could be collected and monitored at the block level where the supervisor would make a visit whenever a process is under-performing. It need not be sent up.

Such a programme manager does not even feel compelled to read the data coming in- the very act of being asked to report is expected to improve accountability

These are some of the main causes of an unwieldy list of indicators. We need to somehow persuade the programme manager to include indicators keeping the logic of hierarchy of indicators as the guiding principle and at each level collect data only for that indicator which is actionable:

II. **Technical merit-1:** Substantive Considerations: Also referred to as scientifically robust indicators: It is important that the indicator measures something of significance and importance within a particular field, and that the indicator is a clear and focused measure. The chink in the fence through which we view the football match must give us a good sense of the whole match. It should be clear how to interpret changes in the level of the indicator and the indicator should be sufficiently sensitive to detect changes in performance. This can be assessed initially by appropriate peer review and later backed by evaluation as to what use was made of it. There are three dimensions of this:

   a. **Valid:** To be valid, the indicator should be representative of the process/outcome that we are wanting to measure in all population groups that it is expected to cover:

      Examples:

      i. The number of condoms distributed per eligible couple: would not be valid measure/contributor to the measurement of couple protection.

      ii. percent of C-sections done is not quite valid measure of management of complications in pregnancy. Of course we use it- but keeping in mind the problem of validity and using interpretation techniques to overcome it.

      iii. BCG to DPT3 ratio is a valid measure of problems of access to immunization.

      iv. percent of children aged 12 to 23 months who got full immunization is a valid measure of immunization access.

The chink in the fence through which we view the football match must give us a good sense of the whole match

v. The indicator 'prevalence of severe anaemia in pregnant women' would not be valid unless all pregnant women had their blood tested during pregnancy.

(There is a related concept of **representativeness**- where we ask not only whether it is representative of what we seek to measure – but whether it is so representative in all populations and sub-groups).

b. **Specific:** An indicator must reflect only changes in the issue or factor under consideration. In other words there will be very few false positives.

c. **Sensitive:** An indicator must be able to reveal important changes in the factor of interest. In other words there would be very few false negatives.

Example:

i. Perinatal mortality rate is sensitive and specific measure of maternal and newborn health, especially mortality, because it picks up still births and neonatal deaths. It is however not sensitive to maternal morbidities.

ii. The proportion of live births which are low birth weight is a valid indicator of maternal health and of care in pregnancy. It is very specific for maternal health measurement but not for care in pregnancy for one could often have low birth weight even where antenatal care was good. It is not very sensitive to either (there are many newborns who are sick and who die who would not be low birth).

iii. Breastfeeding in the first hour is a sensitive and specific indicator of promotion of breastfeeding- and less so for all of newborn care at birth.

III. **Technical merit-2:** Monitoring Considerations - Any indicator also needs to make sense from a monitoring perspective. This would include 3 dimensions:

a. **Reliable:** It produces the same or very similar results, even if measured by different instruments, procedures and/or observers. The indicator has a limited margin of error. This is also similar to the concept of consistency. As the data definitions are improved and data collectors are trained better- the reliability - consistency of measurement could increase:

- **Example:** ANC registration is an unreliable indicator since many persons mean very different things by it despite attempts to standarise it. Therefore even registration at the first trimester scores poorly on reliability. In contrast three ANCs done has a strong reliability. Duplications are much less. Full ANC has so many parameters that it becomes difficult to standardize

and because of varying recall and documentation the quality is quite unreliable.

b. **Feasible**: There is little point in selecting a technically strong indicator for a programme if it is simply not feasible to measure it because of lack of capacity or resources.

- **Examples**: Exclusive breastfeeding is possible on a survey- but simply not possible to collect on a monthly reporting basis- however important it is. Perception of Maternal morbidity varies making it difficult to collect data and aggregate it.

c. **Precise**: This implies whether the data gathering tool or method is precise in its measure.

- **Example**: Newborns referred to higher facilities for ARI is not a precise measure of children with pneumonia - but in comparison children admitted for ARI/pneumonia would be precise- though less sensitive. Pregnant women with anemia is not a precise estimate of anemia in pregnancy but pregnant women with hemoglobin level less than 11gm percent on testing is a precise indicator.

IV. **Coherent and balanced indicator set:** Individual indicator will provide only a very specific and limited perspective of a wider situation. Different indicators (like different gaps in the fence), give different but complementary 'slices' of the whole situation. They need to be added together to get a picture of the entire picture and an understanding of the whole programme.

A set of indicators is needed to comment on progress or performance of a program. Although a good indicator set requires good individual indicators, it does not necessarily follow that a set made up of good indicators is necessarily a good set. There could be too many indicators or too many of a particular type. A good set of indicators should give an overall picture of the adequacy or otherwise of the response being measured. Sets should cover all key elements of the response being assessed. It is important to understand that an individual indicator may be part of more than one indicator set.

ANC registration is an unreliable indicator since many persons mean very different things by it despite attempts to standarise it

A good set of indicators should give an overall picture of the adequacy or otherwise of the response being measured

Peer Reviewing, Field Testing and Approvals

A key process in assessing substantive and monitoring merit is rigorous and exhaustive peer review. It is useful to establish technical resource groups for this purpose. Such a group should have the following:

- Public Health Domain Expertise: in the thematic area of relevance to ensure that they meet substantive merit.
- Monitoring and evaluation expertise to ensure they meet required standards of monitoring merit.
- Programme Implementation experience.

Mission Directors, should insist that the programme managers who are part of the HMIS committee at district level and state level are tested and qualify for knowledge on indicators as defined in Training Manual 2

As part of this process field testing of some of the indicators is also essential. The process of peer review and approval by technical resource group ends when the indicator is fully described/defined as follows.

Fully – described Indicator - should specify the following items:

a. *Title and definition:* For the purpose of this guide, the definition is a clear and brief description of the indicator, which would also define the data elements by which it is computed.

b. *Purpose and rationale:* There needs to be a statement of what the indicator is for and why it is needed.

c. *Method of measurement:* There should be a detailed description of the method of measurement. e.g is it a rate, ratio or percentage and clearly stated numerators and denominators. If the indicator's data is to be disaggregated, for example, by age or sex, details of how this will be done should be provided.

d. *The collection method:* That is, how data elements used for casting the indicator would be collected, including the data source.

e. *The measurement frequency:* That is, how often this indicator will be measured. This should be consistent with the collection method specified. For example, if information is to come from a survey conducted every two years, the measurement frequency should be every two years and not, for example, monthly or quarterly. If the measurement and reporting frequency differ this should be stated.

f. *Interpretation and Use:* Guidelines should be provided as to how to interpret changes in the indicator. For example, what does it mean if the indicator shows an increasing level? If there are different possible interpretations, how can these be distinguished?

g. *Strengths and weaknesses* of the indicator are stated. In particular, common challenges in measuring the indicator need to be stated and practical suggestions given on how to overcome these.

This is what we have tried to do in the indicator dictionary that is part of Training Manual 2. This manual is a must read for every programme manager and every HMIS manager. Indeed Mission Directors, should insist that the programme managers who are part of the HMIS committee at district level and state level are tested and qualify for knowledge on this.

Even after formal learning of the indicators, there is much more learning to be done- which would happen in the course of using it in practice- for each indicator is only one view through the fence- and one has to understand the larger picture by a larger synthesis of information.

When a new programme is launched, or a new indicator introduced, to save on learning time and avoidable errors, it is important to field test these indicators before introducing them into the programme.

Box 3A Description of indicators at the national and state level

These can be reviewed from volume II, Health Programme Manager's Manual (referring page 3-18). Number of indicators are presented with full description of its title, definition, numerator, denominator, method of measurement, frequency measurement, collection methods, common problems, rationale and action for use.

Delivery services					
Indicator	Definition	Numerator	Denominator	Multiplying factor	Suggested level of use
Institutional delivery Rate (Estimated Deliveries)	Percent of deliveries conducted at public institution/facility	Deliveries at public institution/facility	Estimated deliveries	100	National and below
Institutional delivery Rate (Reported Deliveries)	Percent of deliveries conducted at public institution/facility	Deliveries at public institution/facility	Reported deliveries	100	National and below
Home Delivery Rate	Percent of deliveries conducted at home	Number of home deliveries	Reported deliveries	100	National and below
Skilled Birth Attendant (SBA) Delivery Rate	Proportion of total deliveries assisted by a Skilled Birth Attendant (at home and at institutions)	Deliveries by SBA (SBA Home + all Institutional deliveries)	Total reported deliveries	100	National and below
Percent Institutional Delivery Receiving JSY Benefit	Proportion of women who had institutional delivery received JSY benefit	Delivery institutional women received JSY benefits	No. of pregnant women registered for JSY	100	National and below
Rationale	There is clear evidence that institutional deliveries by SBAs are the key to reducing maternal mortality, due to improved emergency infrastructure, access to transport and referral facilities and a number of other factors. In absence of complete estimated population figures in states, the institutional delivery performance can also be calculated by total reported delivery figures. This can supplement the overall understanding of the institutional delivery in the state JSY benefits are given to encourage women to come for institutional deliveries, thus reducing maternal mortality.				
Actions to consider	a. Conditions at institutions should be made more acceptable (culturally, socially, financially etc) to encourage institutional deliveries b. Improved quality of care and BCC				
Complicated deliveries					
Caesarean section rate	Proportion of C-section deliveries out of total reported deliveries.	No. of caesarian section done	Total deliveries (Caesarean section + Normal delivery)	100	state
Rationale	C-section rate reflects on the readiness of the health system to carry out c-section				
Actions to consider	Too few C-sections indicate that health system is putting the health of mother and child at risk as the system is not ready to handle c sec. Too high c-sec would indicate unnecessary C-section are being performed.				

Review Questions

Q1. What is the difference between a data element and an indicator? One way of using data elements to assess a programme is to plot trends and compare it with what is expected. Another is to covert data elements into indicators. What are the advantages and limitations of using indicators to understand the progress of a programme?

Q2. How are indicators categorized and chosen based on a logical framework approach? Create a logical framework design of indicators for reducing maternal mortality.

Q3. What is the meaning of hierarchy of indicators? How does it relate to the logical framework approach? Explain with reference to maternal mortality indicators?

Q4. Enumerate the parameters and steps leading to selection, assessement and inclusion of an indicator in the HMIS format? (these ought to be in place- currently indicators are often included based on perceptions of those in authority- or by copying mechanically from global examples.)

Q5. Differentiate between strong and weak indicators, Explain with examples?

Q6. Which indicators/data elements would you choose to make part of monthly reporting and which would be better gathered by surveys? Why all the indicators are not included in routine reporting. For example – Exclusive breast feeding rate which is assessed by surveys only.

Q7. What is the difference between specificity and sensitivity of an indicator?

Q.8. Give examples of indicators which have most attributes which are needed but are a) not reliable or reproducible b) not precise c) not feasible.

Q.9. In an indicator dictionary for use by a programme managers what are the characteristics that should be described?

Q.10. Develop a monitoring plan and the hierarchy of indicators and assess each indicator for usefulness and technical merit for one of the following programmes. (examples)

a) Nutrition Rehabilitation centers
b) Sick newborn care units
c) School health programme
d) Adolescent anemia programme for high school girls
e) Tobacco prevention campaign.

Note: One should give a group exercise in a topic where the trainees are familiar with the public health strategies required to reach the objective. But it should also be a new programme where they have to think out fresh indicators.

Field-testing

a. Indicators which appear sound on paper may turn out to have significant problems when they are used in practice. For this reason, it is important that new indicators are field-tested. Field testing is best done by introducing the indicators with a set of service providers in a block and watching how the indicators 'behave' over a few months. The service providers would have to be trained in the data collection and the data managers in their use. If the indicators prove to be useful to monitor and act on the programme- then they could be included in the district, state or national list as appropriate.

b. For existing indicators, formative evaluation of their use in practice will provide the same information as field-testing.

c. All indicators are subject to periodic review. This will detect problems with indicators, such as non-availability of data or lack of ability to discriminate between different standards of performance. In addition, situations may change, and an indicator would need to be changed, discarded or added - to adopt in a new situation.

Field testing is best done by introducing the indicators with a set of service providers in a block and watching them behave over a few months

Examples of description of indicators at the global level: (could be learnt from for assessing indicators at district and state levels).

Total fertility rate

Total number of children a woman would have by the end of her reproductive period if she experienced the currently prevailing age-specific fertility rates throughout her childbearing life

Proposed by:

WHO, 1993 - CFM3 'Third Monitoring of Progress of Implementation of Strategies for HFA'

THE EVALUATION PROJECT, 1996 - 'Short list of the Subcommittee on Family Planning'

Useful

- As a measure of poor physical reproductive health since high parity births (>5) are high risk for maternal morbidity and mortality.
- For international comparisons and for monitoring secular trends as it is unaffected by differences in the age-sex composition of the population.
- Requires the calculation of age specific fertility rates (ASFR) - the number of live births occurring to women within a specific age range per 1000 women in that age range.
- ASFRs are useful in reflecting the age pattern of fertility, particularly in the high risk groups of adolescents (see below) and older women.
- Used in the estimation of women's lifetime risk of maternal death (see maternal mortality ratio).

Valid/Representative

- Valid only as a hypothetical measure of expected total number of births per women since it assumes constant ASFRs over time.
- Observed changes in the TFR are not a specific reflection of changes in effective family planning but may be due to changes in the incidence of early pregnancy loss (including induced abortions), to shifts in the age-specific fertility distribution, to differences in the proportion of women 'at risk' of pregnancy or due to other socio-economic factors.

Reliable/Understandable

- As a hypothetical concept, the TFR may be confusing.
- It uses the term 'fertility' as understood by demographers - a measure of live births *not* of conceptions.
- Ambiguity remains over inclusion of live births only.

Feasible/Accessible from:

- Vital registration - but potential problems with underreporting of births.
- Population census - but potential problems with misclassification of age.
- Population- based surveys - but potential problems with response bias and misclassification of age.

Justification for selection

Complementary indicator is the contraceptive prevalence rate.

It was selected because of the lack of feasible alternatives and because it is important in contributing to the estimation of lifetime risk of maternal death.

The crude birth rate was proposed by a number of initiatives but differences in the age/sex mix of the populations of interest make valid comparisons difficult.

A proposed impact indicator aiming more specifically to reflect unmet need was 'the proportion of total births that are to unmarried mothers' but this may not be a valid reflection of unmet need where births outside marriage are wanted.

Contraceptive Prevalence Rate (CPR)

Percentage of women of reproductive age (15-49) who are using (or whose partner is using) a contraceptive method at a particular point in time

Contraceptive methods include female and male sterilisation, injectable and oral hormones, intrauterine devices, diaphragms, spermicides and condoms, natural family planning and lactational amenorrhoea where cited as a method.

Proposed by:

WHO/UNICEF, 1993 - 'Indicators for monitoring health goals of the WSC'

WHO, 1993 - CFM3: 'Third Monitoring of Progress of Implementation of Strategies for HFA'

EVALUATION PROJECT, 1996 - 'Short list of the Subcommittee on Family Planning'

WHO, 1996 - 'Catalogue for Health Monitoring'

UNFPA, 1996 - 'Indicators for measuring the performance of reproductive health programmes - draft report'

Useful

- Useful as an intermediate output measure of utilization of contraception methods.
- The CPR provides no information on the context or appropriateness of the method of contraception and is therefore a weak proxy measure of reproductive 'physical' health. Contraception can only reduce reproductive morbidity and mortality where it is appropriate and safe. Its strongest impact on reproductive health is when it is used to prevent pregnancies that are too early, too close, too late and too many.
- The CPR provides no information on choice - it could only act as a valid proxy measure of other aspects of reproductive health - whose definition includes 'the capability to reproduce and the *freedom to decide* if, when and how often to do so' (ICPD POA, 1994), where the contraceptive method is by the free and informed choice of the individual.

Scientifically Robust/Valid

- Valid only as a measure of utilisation of contraceptives by all women between 15 and 49, irrespective of their 'risk' of pregnancy or need for contraception.
- Can be made more specific by confining to women currently married or in a stable union, and at risk of pregnancy (i.e. those who are fecund, are sexually active and not already pregnant).

Representative

- Depends on the representativeness of the survey sample.
- National measures may hide wide differentials.

Reliable/Understandable

- Needs a clear definition of contraceptive methods - female and male sterilisation, injectable and oral hormones, intrauterine devices, diaphragms, spermicides and condoms, natural family planning, and lactational amenorrhoea method.
- Interpretation is greatly enhanced where data are available on the unmet need for contraception.

Feasible/Accessible from:

- Population-based surveys (may be included in a DHS) - takes into account all sources of supply of contraceptives but potential problems with normative response bias.
- Routine service-based data - but potential problems with incomplete and inaccurate data collection, double counting, inaccurate estimates of the denominator and missing contraceptives acquired outside health facilities.

Justification for selection

The CPR is a complementary output indicator to the TFR.

Proposed direct output measures of physical accessibility of family planning services have the advantage that the information is usually more accessible from health service records but effective utilisation is mediated by many factors of economic, administrative, cognitive and socio-economic accessibility. Indicators encompassing issues of need may be seriously compromised by potential difficulties in reliable data collection.

Percentage of births attended by skilled health personnel

Percentage of births attended by skilled health personnel (excluding trained or untrained traditional birth attendants)

Skilled health personnel refers to doctor (specialist or non-specialist) and/or persons with midwifery skills who can manage normal deliveries and diagnose or refer obstetric complications.

Both trained and untrained TBAs are excluded.

Proposed by:

WHO, 1996 - 'Catalogue for Health Monitoring'

UNFPA, 1996 - 'Indicators for measuring the performance of reproductive health programmes - draft report'

Useful

- As an intermediate output indicator it is a marker of progress towards the process goal of universal access to intra partum care.
- As proxy impact indicator - link between attended delivery and improved outcome.

Valid/Representative

- Valid as a measure of intra partum care coverage depends on the representativeness of the survey sample.
- A national level measure may hide wide differentials.

Reliability/Understandable

- If standard definition of trained health personnel is applied, but ambiguity may remain on the inclusion of trained TBAs and inclusion of private and public providers.
- Ambiguity remains as to the denominator - sometimes includes only live births (leading to overestimation of coverage) and sometimes refers to all births.

Feasible/Accessible from:

- Routine service-based data - provide information on the numerator, but there are potential problems with incomplete records and may miss data from private providers.
- Vital registration and population census - provide information for estimation of denominator, but potential problems with incomplete reporting.
- Population-based surveys - provide most reliable information, but there may be problems with recall bias.

Justification for selection

It is an output indicator for intrapartum care that, if there is a link with outcome, may be complementary to the MM ratio.

An earlier indicator measuring coverage of intrapartum care included all TBA attended deliveries in the numerator and therefore was a less specific reflection of *effective* intrapartum care and a less strong proxy of impact.

Alternative proposed output indicators for intrapartum care included those related to facility-based quality of care which, while potentially useful at the local level, are difficult to aggregate across facilities to produce a useful national measure.

Number of facilities with functioning basic essential obstetric care per 500 000 population

Number of facilities with functioning basic essential obstetric care per 500 000 population

Basic essential obstetric care should include parenteral antibiotics, oxytocics, and sedatives for eclampsia and the manual removal of placenta and retained products.

Proposed by:

WHO/UNICEF, 1993 - 'Indicators for monitoring health goals of the WSC'

WHO, 1993 - 'Indicators to Monitor Maternal Health Goals'

WHO, 1993 - CFM3 'Third Monitoring of Progress of Implementation of Strategies for HFA.

UNICEF, 1995 - 'Maternal Mortality: Guidelines for Monitoring Progress'

EVALUATION PROJECT, 1996 - 'Short list of the Subcommittee on Safe Pregnancy'

WHO, 1996 - 'Catalogue for Health Monitoring'

UNFPA, 1996 - 'Indicators for measuring the performance of reproductive health programmes - draft report'

Useful

- As a direct output measure of availability of basic EOC - a marker of progress towards the process goal of universal access to basic EOC.
- As a proxy measure of impact - direct link between available basic EOC and health outcomes of mothers and newborn.
- Useful at a local level for programme planning.
- Usefulness would be improved if also available disaggregated by rural and urban location of facility per 500 000 rural or urban population.

Scientifically Robust/Valid

- Valid as a measure of availability to general population, but may not reflect true differences in the availability to the population in need (i.e. pregnant women) where there are differences in the proportion of WRA in the population and their fertility rates. A measure of availability per 500 000 WRA may be a more useful indicator.
- It is not necessarily a reflection of accessibility of facilities because contains no information on the geographical distribution, referral systems, transport or cultural and economic accessibility nor on the uptake of this care.

Representative

- National level measure may hide wide differentials between areas.
- Must also include facilities available from the private sector.

Reliable/Understandable

- Need standard definitions of what constitutes basic EOC, but there has been confusion with terminology, 'basic' and 'comprehensive' essential obstetric care, 'essential' and 'emergency' obstetric care.

Feasible/Accessible from:

- Routine service-based data - for the numerator, need evidence that the facilities are functioning, (this should not be a measure of theoretical capacity to provide basic EOC).
- Population census - for information for the denominator.

Justification for selection

As a direct output indicator for basic EOC it is complementary to the MMratio. The information required is relatively easily accessible. With alternative proposed output measures of EOC there are difficulties in calculating the denominator e.g. 'the proportion of women estimated to have obstetric complications seen in EOC facilities'.

Number of facilities with functioning comprehensive essential obstetric care per 500 000 population

Number of facilities with functioning comprehensive essential obstetric care per 500 000 population

Comprehensive essential obstetric care should include basic EOC plus surgery, anaesthesia and blood transfusion.

Proposed by:

WHO/UNICEF, 1993 - 'Indicators for monitoring health goals of the WSC'

WHO, 1993 - 'Indicators to Monitor Maternal Health Goals'

WHO, 1993 - CFM3 'Third Monitoring of Progress of Implementation of Strategies for HFA'

UNICEF, 1995 - 'Maternal Mortality: Guidelines for Monitoring Progress'

EVALUATION PROJECT, 1996 - Short list of the Subcommittee on Family Planning

WHO, 1996 - 'Catalogue for Health Monitoring'

UNFPA, 1996 - 'Indicators for measuring the performance of reproductive health programmes - draft report'

Useful

- As a direct output measure of availability of comprehensive EOC - a marker of progress towards the process goal of universal access to comprehensive EOC.
- As a proxy measure of impact - direct link between available comprehensive EOC and outcome.
- Useful at a local level for programme planning.
- Usefulness would be improved if also available disaggregated by rural and urban location of facility per 500 000 rural or urban population.

Scientifically Robust/Valid

- Valid as a measure of availability to general population, may not reflect true differences in the availability to the 'population in need' (i.e. pregnant women) where there are differences in the proportion of WRA in the populations and their fertility rates. A measure of availability per 500 000 WRA may be a more useful indicator.
- It is not necessarily a reflection of accessibility of facilities because contains no information on the geographical distribution, referral systems, transport or cultural and economic accessibility.

Representative

- National level measure may hide wide differentials between areas.
- Need to include private facilities.

Understandable/reliable

- With standard definitions of what constitutes comprehensive EOC, but there has been confusion with changing terminology, from 'basic' and 'comprehensive' essential obstetric care to 'essential' and 'emergency' obstetric care.

Accessible from:

- Routine service-based data - for the numerator, need evidence that the facilities are functioning, not a measure of theoretical capacity.
- Population census - for information for the denominator.

Justification for selection

As a direct output indicator for comprehensive EOC obstetric care it is complementary to the MM ratio.

The information required is relatively easily accessible.

There are serious problems with alternative proposed output measures of comprehensive EOC for example - 'caesarean sections as a proportion of all live births in a population' - problems with estimation of the denominator and, where the result lies within the 'normal' range of 5-15 percent, difficult to interpret if the sections were appropriate. 'The proportion of all births that occur in facilities with EOC' present similar problems of defining what is acceptable and if those that are attended to in these facilities are the appropriate deliveries.

Perinatal Mortality Rate (PNMR)

Number of perinatal deaths per 1000 total births

Perinatal deaths are occurring during late pregnancy (at 22 completed weeks gestation and over), during childbirth and up to seven completed days of life.

Proposed by:

WHO, 1993 - Draft list suggested in 'Elaboration of Indicators for Maternal Health'

EVALUATION PROJECT, 1996 - 'Short list of Subcommittee on Safe Pregnancy'

Useful

- As an impact indicator it is a direct measure of perinatal health status and a marker of progress towards improved perinatal health.
- Potential as a proxy measure of maternal health status.
- At the local level, useful to record each perinatal death and to review circumstances of the event - leading to specific recommendations for programme planning.
- Usefulness would be improved if also available disaggregated by a) source of data: facility versus community-based b) fresh and macerated stillbirths.

Scientifically Robust/Valid

- A valid measure of risk of fetal or neonatal death in the perinatal period - defined as from 22 weeks of gestation (WHO ICD10, 1992) until seven days after delivery.
- Observed differences in the PNMR may not be specific to improved health status but may be due to changes in the reporting system for ascertainment of perinatal deaths.
- Specificity as a proxy measure of maternal health may be low where observed differences in the PNMR primarily reflect changes in neonatal care.
- As a more common event than maternal deaths, potential as a more sensitive measure than the MM ratio of changes in overall maternal health status.

Understandable/Reliable

- Ambiguity remains over the definition of a stillbirth (vs a spontaneous abortion). ICD 10 now defines the perinatal period as commencing at 22 weeks; any fetus delivered beyond this gestation, or with a birth weight over 500 g, is therefore included in the perinatal statistics. However, for international comparisons a birth weight of at least 1000 g is recommended (WHO, 1996c). Presentations of PNMR must always specify the birth weights included in the statistics.
- Interpretation can be enhanced using indicator on the percentage of births attended by trained health personnel.

Accessible from

- Vital registration - but potential problems with underreporting of births, differential non-response for deaths and misclassification of perinatal deaths (as abortions or late neonatal deaths).
- Routine service-based data - but potential problems with unrepresentativeness of sample.
- Population surveys - but potential problems with recall bias and differential misclassification.

Justification for selection

Despite major problems in reliable data collection for the PNMR it is included in this list as an impact indicator that has great potential as a sensitive indicator of maternal and neonatal health status.

As perinatal death is a more common event than maternal death, the PNMR has potential as a more sensitive measure of change. Ascertainment of perinatal death is less problematical than ascertainment of maternal morbidity, which has been suggested as a more sensitive alternative measure of maternal health status. At the local level, reviews of perinatal deaths provide more opportunity for examination of quality of care issues than the rarer maternal death reviews.

Alternative measures of newborn health status include the infant mortality rate (IMR). An estimated 40 percent of infant deaths occur in the first week (WHO, 1996). However observed changes in the IMR are not specific to changes in reproductive health status and reductions in IMR over the last decade largely reflect a reduction in post neonatal mortality.

Percentage of live births of low birth weight

Percentage of live births that weight less than 2500 g

Proposed by:

WHO, 1993 - 'Elaboration of Indicators for Maternal Health - Draft list'

WHO, 1993 - CFM3 'Third Monitoring of Progress of Implementation of Strategies for HFA'

WHO, 1996 - 'Evaluating the Implementation of the HFA'

Useful

- As an impact indicator - a direct measure of newborn health and chance of survival, and therefore a marker of progress towards improved newborn health.
- As a proxy indicator of maternal health status.
- Useful to collect data on birth weights at local level - to inform individual case management.

Scientifically Robust/Valid

- Valid as a measure of prevalence of live births with birth weights under 2500 g - either due to intrauterine growth retardation, premature delivery or genetically small stature.
- Specificity as a measure of health status and chance of neonatal survival is compromised in populations of genetically small stature, where birth weights below 2500 g are normal and not associated with increased risk.

Representative

- Routine data will provide an unrepresentative sample.

Accessible from:

- Routine service-based data - but potential problems with unrepresentativeness of sample – has potential for monitoring trends, but increasing prevalence of LBW births in health facilities may reflect improved access for women in need.
- Population-based survey - problems with incomplete recording of birth weights in the community and recall problems, in special surveys can use a proxy measure of LBW e.g. chest circumference, which may be easier to measure.

Justification for selection

As a measure of newborn risk it is complementary to the PNMR; as a reflection of maternal health status it is complementary to the MM ratio.

Despite major problems with reliable data collection this indicator was selected owing to its multiple potential: as a measure of newborn health status and chance of survival and as a proxy measure of maternal health. As it is of multiple aetiology, it can be regarded as an efficient marker of health status of the mother - a high LBW prevalence reflects a number of negative factors.

While reliable population level estimates may not be feasible, monitoring of changes in the data that are available (i.e. health service data) gives an indication of trends.

In areas of small genetic stature a lower cut-off for definition of low birth weight would be more appropriate as a reflection of health status and chance of survival.

HIV prevalence in pregnant women

Percentage of pregnant women (15-24) attending antenatal clinics, whose blood has been screened for HIV, who are sero-positive for HIV

Adapted from:

WHO, 1996 - 'Catalogue for Health Monitoring'

Ethical

- Data collection should be through an unlinked anonymous serological screening.
- A necessary precondition is that it should be accepted antenatal care practice in the country to screen all pregnant women for syphilis sero-positives. The blood for HIV testing is "leftover" blood originally collected for syphilis screening of pregnant women.

Useful

- For evaluation of HIV trends in the general population, the use of 15-24-year-old HIV sero-prevalence in antenatal clinic attenders is subject to problems of bias because of exclusion of certain groups of women (in particular, the infertile) and because of the changing age structure of the infection over time.

Scientifically Robust/Valid

- Relatively large sample sizes (minimum of 3000 individuals aged 15-24) are needed to ensure adequate precision of the estimates.
- Estimates of prevalence should be given with confidence intervals.

Representative

- Weak representatives of the general prevalence of HIV in the population because antenatal care attenders are generally not considered high risk for HIV infection.
- As a consequence of the modes of transmission of HIV, urban and periurban areas tend to have higher HIV prevalence than rural areas. This should be allowed for by oversampling urban and periurban areas.
- For a predominantly sexually transmitted infection such as HIV, changes in the prevalence in the immediately post-pubertal age group closely reflect changes in the incidence in that age group. However, it may not be appropriate to extrapolate this hypothesis to a 10-year age band.

Reliable/Understandable

- If applied appropriately according to definitions and methodology cited.

Accessible from

- Cross-sectional sero-surveys among women aged 15-24 year attending antenatal clinics.

Justification for selection

Only justifiable in certain settings to due to the operational complexity of the measuring the indicator, its relative lack of sensitivity in detecting changes in HIV prevalence and the inherent biases involved in sampling only women attending antenatal care clinics.

4 Capacity Building for Health Informatics

In this chapter we shall learn:

a. The components of capacity building in the context of health management information systems.
b. The strategies involved in capacity building in the NRHM context.
c. The experience and lessons of capacity building from a few states.
d. How to build and assess capacity at state and district levels.

Capacity is "the ability to carry out stated objectives". It has also been described as the "stock of resources" available to an organization/system. It is also indicates towards the process that transforms resources into performances.

Many programme managers equate capacity building with training. If there is a gap in performance, the solution proposed is often to hold a workshop to "retrain" or "refocus" the individuals whose performance was faltering.

But individual skills are only part of the complex mixture of elements that constitute the "capacity to perform a certain function or groups of functions" effectively and consistently over time. Individual programme managers, no matter how skilled, are unlikely to run a health management information system without adequate software and equipment, without proper motivation and support, without enabling orders and work allocations and without a good relationship with the service providers and other staff of the system. Capacity building may be required in all of these and other areas to ensure that performance goals are met.

Capacity Building may therefore be defined as the development of sustainable skills, organizational processes, and infrastructure along with a commitment to improve health (or any other sector/institution) with an objective to prolong and multiply health gains many times over. What constitutes capacity building in practice can vary enormously, and the concept continues to develop as field experience grows.

Capacity Building may therefore be defined as the development of human resources, organizational processes, and infrastructure along with a commitment to improve health outcomes

Capacity Building is much more than training, it includes human resource and organizational process and infrastructure development

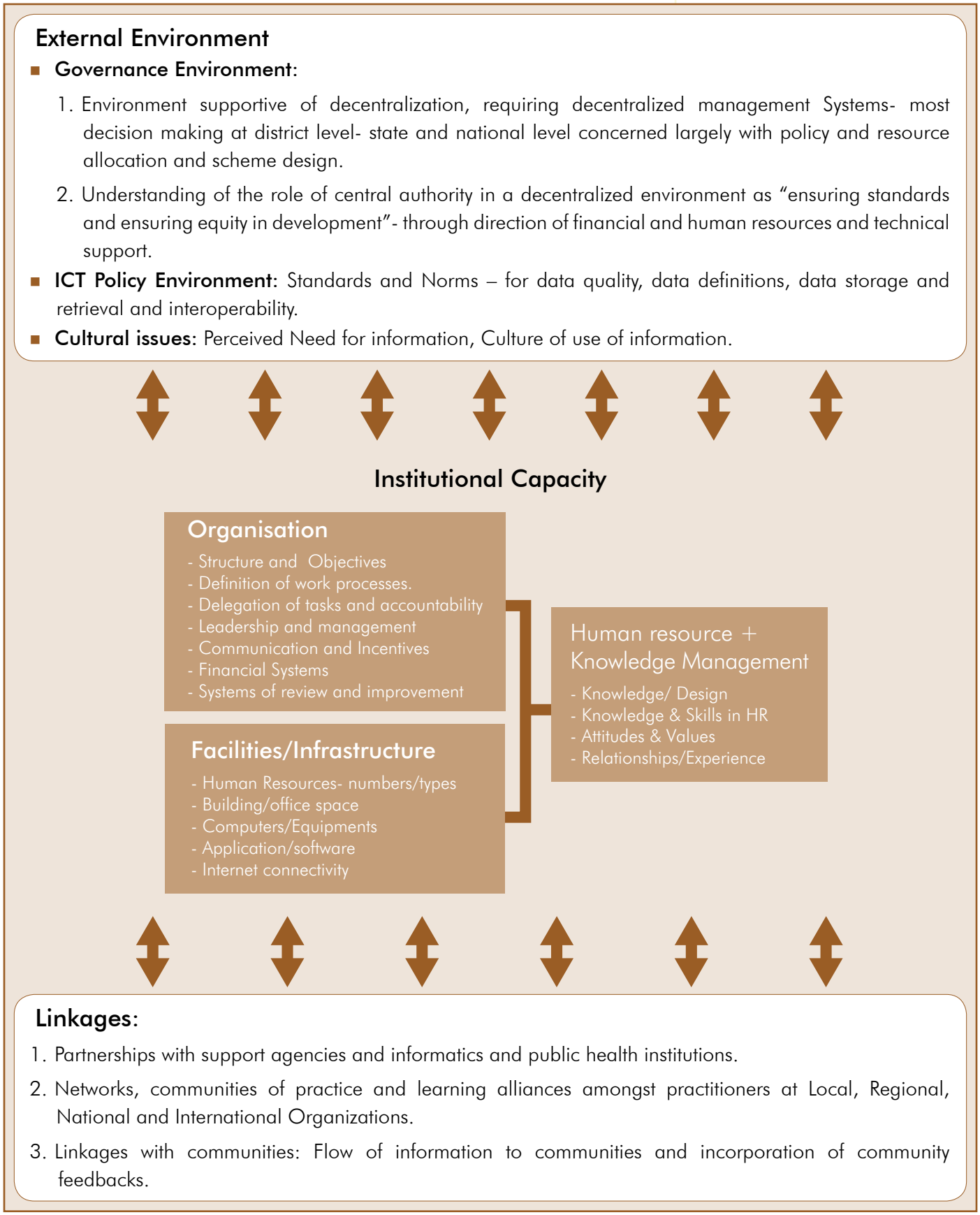
Capacity Building is much more than training. Capacity building includes the following:

1. **Human resource development:** This includes training, recruitment, utilization and retention of the managerial, professional and technical talent that is needed for task performance at the organizational level. Attracting technical people to public sector careers and putting in place processes to use talents effectively; and matching skills with positions and responsibilities is part of the challenge of capacity development.
2. **Organizational development:** is the elaboration of management Structures work flow, processes and procedures, within organizations and the management of relationships between different organizations/ sectors (public, private, community). This includes placing competent professionals at each level, to define and streamline work channels, and to institutionalize process documentation and reporting systems.
3. **Infrastructure Development (at all levels):** the office space, the computers and furniture, the software and applications, and the internet connectivity.

We call all three dimensions of capacity taken together as Institutional Capacity Building for HMIS.

Human resource development	Infrastructure development	Organisational development
Recruitment and positioning of data entry operators and HMIS managers. Assigning programme officers to HMIS teams. Recruiting technical support agency.	Availability of computers and customization of available software applications to match needs.	Establish HMIS teams. Define information flow. Formulate guidelines for data collection, aggregation, verification
Induction training of 1. data entry operators and 2. HMIS managers and 3. programme officers and 4. Service providers and their certification in required competencies	Office-space and full time staff required for the task.	Establish formal supervision & monitoring, Design and institutionalize recording and reporting systems
Hand-holding arrangements- through deployment of TA agency support personnel- similar to use of fellows	Internet connectivity at each level (preferably at Block level) Purchase of server.	Structure the evidence -based decision making process. Develop formal feedback processes
Development of capacity to assess and improve on quality gaps and to promote use of information. Skills of data analysis and interpretation.	Budgets and financial management for recurrent costs.	Develop and utilize appropriate evaluation strategy
Strategy for sustainability of HMIS skills- interface with institutions and networks- so that staff turnover can be addressed. Improved workforce management policies to ensure retention of trained staff and career path for this category of skills.	Maintenance contracts for hardware. Staff/contracts for server management. Staff/ contracts for software up-gradation/trouble-shooting.	Linkages with informatics institutions and public health institutions for continual improvement

Figure 1:Diagrammatic overview of Institutional HMIS capacity with linkages needed to ensure performance:



Technical and Management Skill Building: The Training Component

Training is a process where specific competencies (skills, knowledge, and attitude) are imparted to trainees. Such competencies are expected to contribute to better job performance. Trainings build trust and teams who are committed to one endeavor.

Many factors contribute to a successful training programme. Clarity on what should be the objective of the training, who would be the trainee and therefore who would be the trainer and what would be the training process needs to be looked at carefully. Further resources required to organize the training and training schedules/frequency need to be well understood.

Training is a process where specific competencies (skills, knowledge, and attitude) are imparted to trainees. Trainings build trust and teams who are committed to one endeavor

Designing of an effective training strategy for a programme has several aspects that must be considered distinctly. These are described below:

1. **Defining training objectives**: Well defined objectives provide clear guidelines and a systematic plan. It helps to ascertain expected outcomes and monitor progress. Clearly defined objectives help trainer and trainees to establish a relationship between various segments of the training and to stay focused. Objectives for any training programme always needs to specify in writing, in as much detail as possible the precise competencies we want to develop in the trainee. And one can evaluate to ensure that these outcomes-competencies- were achieved.
2. **Identification of trainees and training requirements**: Trainees will be selected on the basis of the objectives of the healthcare service/ program. Define and understand the level of competencies required by the programme in these identified trainees and how these lead to their improved performance and the desired programme outcomes. Then also describe the number of similar trainings attended by them in the past and their current level of competencies as compared to the list of essential and desirable competencies. Re-training on a standard plan- often leads to emphasizing what is already known and missing out – yet again- on the gaps in their knowledge.
3. **Training plan**: A training plan has detailed information about each and every section/session of the training along with the expected outcomes at the end of the session. It provides a systematic graduation in knowledge and skills as the training proceeds. It should include in the least training venue, training schedule, the trainers and how they would be trained and accredited, the logistics plan including availability of good quality training material, and the training evaluation plan.
4. **Selection of training methodologies**:There are number of effective teaching methodologies for enhancement of competencies. Selection of right methodology should be in context of the training objectives and

Objectives for any training programme always needs to specify in writing, as much detail as possible the precise competencies we want to develop in the trainee

the trainees. Whatever be the training methodology, communication should be effective and participation should be encouraged.

5. **Role of facilitator:** A training facilitator must be identified before hand and role should be well defined to ensure the smooth execution of the training programme. Management of logistics and finances is very important, but should not distract from training content and evaluation. Therefore often it is worth separating the two functions.
6. **Monitoring and Evaluation of Training:** The Assessment of competencies: Success of training program can be assessed by measuring the change in knowledge and skills of the trainees before and after the training. Administer competency tests and analyze test scores. These tests should be very non-threatening so that participants appreciate that the purpose of the training is to learn and perform better at work rather than to score well on the test. The more important purpose of training evaluation is to identify gaps in the trainers' performance and training process- with respect to which competencies failed to get communicated adequately – so that subsequent trainings can be improved and current training can be rectified.
7. **Refresher training and supportive supervision**: It is critical to provide on the job support to the trainees so that they can translate classroom learning to their work. Peers and supervisors should encourage and facilitate trainees to use new knowledge and skills. Needs for refresher trainings and supervision at work should be assessed and provided as a follow-up.

HMIS trainees can be broadly categorized into four groups

1. **Service Providers:** ANMs/LHVs/MPHW and Medical Officers in-charge of facilities.
2. **Program Managers:** District Programme Managers, Block Programme Managers, the chief medical and health officer of the district, the block medical officer, the Reproductive and Child Health Programme Officer, the Officer in charge of Immunisation, Family Planning, Disease control programmers etc.
3. **HMIS Managers:** Data Entry Operators, Data Managers/Monitoring and Evaluation Managers/Statistical Officers, HMIS Consultants. If the volume of data entry work is high there is a case for having a district HMIS manager as separate from a data entry operator. The HMIS manager could be synonymous with those in a district health planning or resource unit.
4. **HMIS Resource Persons:** National and State Level HMIS deciosn makers, trainers, technical consultants providing support to implementation of health informatics programmes, M&E senior

Training programme should be designed according to the needs and level of the target groups

expertise, Directors of Health Services, Mission Directors and Secretaries of Health.

The training content

The table below describes the training content in terms of competencies and categorizes it into essential, desirable and not needed for different categories of trainees. It takes approximately one day to train anyone on one of these competencies. Further rounds of training would be needed for HMIS manager and programme managers for use of information.

Competency	Evaluation of Competency…	Service Providers	Programme Managers (users)	HMIS Managers
1	Data Guidelines (definitions, sources and collection rules)	Essential: for collecting and reporting data	Essential to supervise data collection, and interpret information	Essential- to supervise data collection
2	Indicators	Desirable- Limited use for understanding their role better	Essential - to make use of data collected.	Essential- to present information to users - to identify data quality issues
3	Data Quality issues	Not Needed (except as pertains to 1)	Essential - to identify and understand and improve quality of data	Essential- To identify, measure and trouble-shoot data quality issues
4	Use of information for programme management	Not needed	Essential- skills to interpret and apply information: This represents the main output of the entire process. Needs	Desirable- to understand and cater through feedback forms to user needs
5	Using the National Web Portal	Not needed	Not needed – unless as back up	Essential- to train and supervise data entry operaators
6	Uploading and reading data on district/state applications – e.g. DHIS2	Not needed	Not needed- unless as back up	Essential- to train and supervise data entry operators
7	Use of applications for Analysis and Feedback of information	Not needed	Desirable- to be able to do data analysis on ones own.	Essential- to provide appropriate information to users
8	Design Issues- choice of indicators, monitoring, evaluation and improvement of data systems and its use	Not needed	Desirable- so as to express information needs better	Desirable- so as to contribute to assessment and improvement of outputs
9	IT applications – development skills	Not needed	Not needed	Not needed – could be outsourced
10	IT applications- maintenance and customisation skills	Not needed	Not needed	Desirable- to contribute to improvement of outputs.

Training methodologies

For HMIS training the chosen methodologies are:

a. Participatory classroom training
b. On the job mentoring and support.

Details of why and how to make training participatory can be found in standard guidelines on training. One could also refer to Public Health Resource Networks' special volume on training (module 5) for more details on training strategy.

Training strategy

There are three essential components of any training strategy that has to train a large number of trainees:

a. A good set of resource material which is followed systematically in the training sessions.
b. A good set of state level trainers- who are proficient in this task and preferably who are full time on HMIS work.
c. A good in built evaluation programme which is seriously conducted and where only those who pass the test are accredited. The feedback from which is used to improve training and select trainers for future training sessions.

In addition a supervisor or a HMIS fellow who travels to the states and districts and works for a few days with each in uploading data would make a big difference.

A good in built evaluation programme which is seriously conducted and where only those who pass the test are accredited

Systems Approach to Capacity Building:

Inputs	Process	Output	Outcomes
Establish Guidelines/ protocols.	Issuing Guidelines for data collection, flow, and compilation.	Functional teams that manage data flow, make use of information & address data quality issues – at district and state level.	Improved monitoring of all programmes.
Organizational structure of Public sector and Plan for HMIS in place.	Formats and registers in place.	Regular monitoring outputs: Timely analysis and dissemination of information to managers.	Evidence Based Planning.
Office space, computers, connectivity.	Guidelines for validation and verification and error management.	Accompanying Measured statement of degree of completion and accuracy of reporting.	Better allocation of financial and human resources.
Recruitment/deployment of human resources.	Protocols for assessing gaps eg District assessment tool).	Information based local planning and programme implement.	Quality Assurance and improvement in service delivery.
Budgeting- Financial Resources.	Training of Human Resources- service providers, programme managers, HMIS managers.	Multiple sectors strategy involvement.	Community involvement and feedbacks.
Software applications to support HMIS.	Establishing teams, delegating authority.		Improved Accountability.
Technical Consultancy services for capacity building/applications customisation & maintenance.			Capacity to assess and cope with external environment.

Case Studies: Capacity Building on Scale

Case study-1: Uttarakhand – HMIS capacity building at the state level

Problems of scaling up and uneven infrastructure

Uttarakhand is a state in Northern India, which has various districts nesting in the foothills of the Himalayas, making access - both physically and electronically - a challenge:

Internet connectivity is the major issue in implementing facility based health information system

1. The state started to implement their state HMIS, in December 2008, initially based on a district model. This implied that each district would get their different facilities to submit on paper their monthly reports, to the district HMIS officer, who was then responsible for manually aggregating the report for the district, and then entering it into the customized applications, which was deployed over the state server. The district aggregated report was then uploaded into the national web-portal. Components of capacity building:
    a. Computers installed in district and state offices with internet connectivity. Also one data entry operator recruited and deployed for every district. These were achieved in the year 2007 itself.
    b. Skill building for uploading data in national web-portal and in district health information applications called DHIS 2, for District HMIS operators. Also a brief training of data formats for service providers.
    c. DHIS 2 applications installation at the district and state levels and its customisation for districts. Customisation involved not only providing for every data element required in the formats, but also entering the name of every district hospital and the aggregate of data from the other facilities in the district as separate reporting units. Each district was an Organising Unit. Each facility which generates a format is a reporting unit. At this stage the applications had provision only for entering the organizing unit data and the consolidation of data from all reporting units was done manually.
    d. Facilitation by field visits of national team members to follow up with the data entry operators to ensure proper data aggregation and uploading onto DHIS 2 and from there onto web-portal.
    e. This phase lasted about six months- upto about May-June of 2009.
2. After about six months as the district based process of reporting was stabilized, the state took the next step of scaling-up, by getting sub-district (called Block) based data aggregation which were loaded as such. Though the data entry was done at the district level for want

of computers in all block, but the unit of data entered was the block level consolidated data. The block consolidated data was prepared at the block level by aggregation of data from all PHCs, sub-centers and the CHC. This was sent on paper to the districts. To enable its data entry, the list of all the blocks by districts was provided to the technical support agency managing the application. Each block was now represented as a "Organizational unit" and placed in the data-base with reference to the district they belonged in what is called a "Organization unit hierarchy". The district consolidated report was generated electronically by the DHIS2, and this way the state and district managers could drill down to the blocks, to identify performance issues. At this state capacity building consisted of:

a. Deploying computers at the block level.

b. Skill Building on data definitions, data collection process and reporting for service providers (synonymous with what is called competency 1 earlier in the test) and some amount of skill building on data quality problems being encountered for Data Managers.

c. Established the process of data validation and verification to improve data quality. Also improved completeness of data reporting.

d. Establish official HMIS teams at state and District level.

e. Handholding provided by facilitating the state with a full time HMIS fellow trained and supported by the NHSRC.

f. This phase lasted almost a year- upto about June of 2010.

3. Once this process was stabilized, the state took the decision to now scale the systems one step further: by now getting data disaggregated to facilities. For this, it was important to do the data entry at the block itself, otherwise the load of data entry at the district, would be huge. However, while computers were available at the block level, internet connectivity was not present. Thus online data entry at the block level was a problem. To deal with this, offline installations of DHIS2 were made for each of the 95 blocks in the state. These applications now had an "organizational unit" defined (in the software data base) for every "reporting unit". Further the data-base had the specific hierarchies defined- which sub-centers belonged to which PHCs, which PHCs belonged to which block. This is called the organizational unit hierarchy and this had already been established for blocks and districts. These customized applications was then installed in the respective block computers, training was provided to the staff on how to enter data by their respective facilities and export the monthly data into a file, which would either be saved on a USB stick and sent physically to the corresponding district, or, by email using a dial-up connection. Potentially at the block level they could also analyse the

Online data entry at the block level was a problem. To deal with this, offline installations of DHIS2 were made for each of the 95 blocks in the state.

data by facility and give a feedback to the facilities and prepare their own block level data analysis. At the district office, this data would be imported into the online application, which would then be hosted on the server and shared with the national web-portal as required.

At this stage capacity building required:

a. Putting in place a HMIS data entry operator in every block and also a computer with attempt to secure internet connectivity.

b. Customization of application to include facilities and aggregate at block level and provide analysis feedback to facilities.

c. Skill building in aggregating and uploading data on DHIS2/web-portal for block level HMIS operators: (competency 5 and 6 as described earlier).

d. Skill building of district teams as master trainers in competencies 1, 2 and 3. Training of service providers yet to begin.

e. Initiated backward flow of issues addressed in the data (State to Districts).

f. Further measures to improve data quality- especially with respect to timeliness of data reporting.

g. Role of a HMIS fellow at state level shifts from data uploading support to data quality management and use of information.

h. This phase lasted one year – from June 2010 to June 2011.

Planned/Proposed capacity Building in coming one year:

a. Complete the training of all service providers in competency 1 and ensure that they all have a copy of data guidelines in Hindi.

b. Training of all programme managers in competency 4- the use of information.

c. Regular dissemination of facility level analysis of performance from block to facilities and block level analysis of performance from district to block. Using this to strengthen supervisory and planning processes.

d. Established process of data triangulation – comparisons with DLHS/AHS data to build confidence in data and validate it.

e. Assess data quality issues in every district and score and rank them based on data quality.

f. Need to introduce a HMIS manager in addition to data entry operator at the district level to manage the system- play the role that the HMIS fellow was to have played.

g. Introduction of on line data entry at the level of facility itself by computers and mobile based data entry for sub-centers.

Regular dissemination of facility level analysis of performance from block to facilities and block level analysis of performance from district to block. Using this to strengthen supervisory and planning processes.

In this way, the challenge of very uneven ICT infrastructure and capacity for HMIS, even within the same district and block, could be systematically addressed using a mix of varying technological solutions, and synchronizing it with different institutional practices and skill development to match these revised technical configurations.

Challenges

1. Resistance of staff in moving towards the electronic system from paper based system.
2. IT infrastructure resource non – availability (like computers and internet connectivity).
3. Offline systems work poorly and technically difficult to manage. Online systems require better web-connectivity. Offline systems requires continuous troubleshooting.
4. Greater involvement of programme staff in HMIS and its use. The creation of functional effective HMIS teams with clear roles and responsibilities assigned. Properly viewing the data at the time of verification at each level, properly identifying data quality issues and solving them, properly reading information and using them.
5. Need to expand server capacity and maintain the server at the state level. The database had to be scaled to be able to handle data from 1765 Sub-centres (consolidated), 246 Primary Health Centres, 51 Community Health Centers, 18 District and sub district hospitals, and also private institutions. Server performance had to be constantly monitored and fine tuned to ensure it could handle the load of simultaneous users entering data in the last week of the month.

Greater involvement of programme staff in HMIS and its use. The creation of functional effective HMIS teams with clear roles and responsibilities assigned.

Review Questions

Q.1 What is the difference between training and capacity building?

Q.2. What is the difference in training requirements between service providers, programme managers and HMIS managers?

Q.3. What are the infrastructure requirements for an effective health informatics programme at a district level to manage the public health programme and monitor service delivery?

Q.4. In terms of organizational development, what are the mandatory components and which of these are weak in your district?

Q.6. Draw up a capacity building plan for HMIS in your district/state? Mention the number of persons required and the competencies they must have, as well as infrastructure and organizational development plans.

5 The Use of Information in Health Programme Management

In this chapter we shall learn:

a. Why use of information from HMIS remains a problem even when information is available?
b. Identifying and meeting information needs of public health management at National and State Level.
c. Identifying Needs and Using information in district and sub-district levels.
d. Measures to improve use of information.

Current Situation in Use of Information

Sound and reliable information is the foundation of decision-making across all health systems and is essential for health programme planning and implementation. Data by themselves do not always tell a straightforward story; meaning is acquired when they are analysed and interpreted. Data should be synthesized, analyzed and interpreted within the overall context of the health systems functioning as well as the specific programmes of health care delivery/intervention. A critical aspect of analysis is the synthesis of data from multiple sources, examination of inconsistencies and contradictions, and summarization in view/context of the health situation and trends. There is also a need for some basic understanding of both the theory and practice of public health. One popular adage of clinical medicine which is equally applicable to public health which expresses the relationship between theory and empirical observation is "that the eye does not see, what the mind does not know". This is equally true for those who would make use of information from HMIS.

Six years after the introduction of HMIS under NRHM and three years after work began on the "new HMIS" or HMIS reform was rolled out- (using October 2008 as the baseline point), the use of information is still poor. Further, the use of information is disproportionately poor as compared to the availability of information. Further it is poor across states- whether good performing or poor performing on other dimensions. Of course we must

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In this chapter we try to look beyond the simplistic "motivation" explanation for more systemic, design level and therefore universal problems, that are acting as constraints in the use of information

note that use of information is many times more than the base line situation in the year 2007 and between states there are huge differences.

Whereas many other reviews- like common review missions and evaluation studies have identified poor use of data as a problem, most of these sources have looked at data quality issues, and skills and motivation of the mid level managers as the constraints. We have discussed data quality issues earlier. But in this chapter we try to look beyond the simplistic "motivation" explanation for more systemic, design level and therefore universal problems, that are acting as constraints in the use of information. These explanations are based on the experience of the last three years of NHSRC in promoting the use of information.

Constraints to Use of Information

1. The health information system is equated with "monitoring" and this is broadly perceived as holding service providers and lower level managers accountable. The understanding is that with plans, funds and enabling mechanisms all in place- the task of the providers and managers is to walk on the lines laid down, and the task of HMIS is to observe whether they are indeed doing so, enabling higher level officials to "drill down" and be able "to see" the errant facility or even preferably the errant employee. Though there is the potential to drill down and observe every facility, every employee and (with pregnancy and child tracking) every beneficiary- in practice senior officers do not have the time and space to do so. A further perception is then added on ...that even if actual observation does not happen, merely the feeling that they are being closely observed on every action, would motivate service providers and managers to do their tasks better. This is one reason for adding more and more data elements and asking for further and further levels of "visibility" before the superior officers' gaze. Unfortunately in practice, this increased visibility does not work to improve functioning of service providers and mid level managers. Rather the system at all intermediate levels aims to lower this "visibility"- either by marking up values of data elements which are most observed, or even by themselves discrediting and undermining the entire HMIS process or by other innovative subversion (e.g. systematic double counting of some entries etc.).
2. The HMIS function, as it has historically evolved, is led in the health department- both at the center and in the states by officers from a cadre of statisticians. At the center the Central Statistical Organization has about 800 statisticians who are placed across most departments and ministries, with about 40 in the health department alone. Their approach to HMIS is to basically study the statistically significant trends, noting perturbations from this trend as statistical outliers and

also crunching the data from across the nation to arrive at some state level health status analysis. There is little or no support to use of health information for public health management at the district and sub-district level. The only action conceived of is reprimanding those reporting less than required for a good performance. In training programmes, district statistical officers have even complained that they are being required to learn a lot of public health details which is not their task at all (though after the initial reluctance they enjoyed the learning experience). The problem with the statistics driven approach is that, though it is useful for looking at large aggregations of data at state and national level, it is of little use for public health planning at district or sub-district level. But when it comes to the larger aggregations, the lack of data from the private sector, which provides the bulk of care deprives HMIS of the ability to comment on health status or even access to services. It potentially could comment on the efficiency and service delivery of the public health facilities, but here the varying quality of data when we have across tens of thousands of reporting units undermines the ability to use the information. All statisticians understand the need to keep the sample size in a sample as small as possible to give the minimum level of accuracy of data needed. If the sample size increases accuracy of data increases - but non-sampling errors in data collection reduce the quality so much, that a smaller sample is more reliable. HMIS data of all public health facilities is like a very large sample, full of errors of data collection and aggregation.

The problem with the statistics driven approach is that, though it is useful for looking at large aggregations of data at state and national level, it is of little use for public health planning at district or sub-district level

3. The design of the national web-portal for HMIS sought to gather the information in one place and then analyse it centrally and make it available through the same portal to the districts. A web-portal is a repository, meant to be a portal of access to a wise variety of users. The design should allow the repository from multiple routes and sources. Unfortunately often web-portals became a portal of 'entry of data' instead of being a 'portal of access to information'. The central office had to publish and disseminate the analysis of the data periodically and all others were dependent on this analysis. The software applications chosen for data analysis are SAS, which is one of the most sophisticated and expensive statistics packages available was quite beyond the reach of any district officer to manage. It is also very costly to purchase with huge licensing fees. Unfortunately during the entire seven years of the NRHM it also proved well beyond the reach of central officers also, who never got used to it at all- and like the "visibility functions" of the HMIS which we discussed earlier, the privileged position of the statistical officer, is more notional than real. These are not to be mistaken for deliberate ploys by specific officers or individuals- but the sort of relationships that underlie institutional structures- and designs.

Given the prevailing culture of merely implementing vertical programmes, the need for decentralized planning was poorly felt and therefore the need for data and the culture of using data was never established

4. Yet another potential use was, its use in policy. Public health programme managers and administrators did seek to use it for this purpose. But repeatedly, they fell back on using the national surveys- NFHS and DLHS and have now put in place an annual health survey on the lines of DLHS. The difficulties in use of HMIS data for policy purposes could be enumerated as follows:
   a. Private sector data is not available- and this could contribute a major part of the data needs.
   b. Context made a huge difference to data interpretation- and sitting at a state or national office, one cannot interpret in context. One could however do so if one was in the district. To give one example: in one block the access to service delivery may be surprisingly low because the users are going to the district hospital of the neighbouring district, which is nearer than their own district hospital. This would be obvious to the district manager who would factor this in whilst interpreting the data.
   c. Survey data is seen as external evaluation. HMIS data is internally generated by service providers and such data is held to be inherently unreliable. There is clear evidence NHSRC work, that false reporting by service providers is much less than expected, though substantial marking up of data occurs at intermediate- especially the district and higher levels. Whatever the level/site of falsification, the net result is to undermine its use for policy purposes.
   d. HMIS data has been plagued by problems of data quality, described in some detail in the first chapter. This also makes it difficult to use for policy purposes- and certainly it is far less reliable for policy than the surveys.

5. All the above reasons do not apply to the use of information for district public health management. The available data, is good enough for a large number of useful planning and management decisions. Interpretation could be done in context and even errors in data could be corrected as and when encountered by checking with primary records. However – use of information for decentralized management purposes has been very limited. Some of the reasons for this are given below:

   a. Many states do not have any applications that assist in data analysis at the local level. Only Rajasthan, Tamil Nadu, Maharashtra and 14 states using DHIS 2 have had access to such a facility. The 18 states without a local decision support applications could have used offline Excel sheet based analysis, but in practice only Assam did so and even that to a very limited extent.

   b. States which did have DHIS2 had the potential to analyse and use information, but the focus of all training and support was so narrowly focused on uploading of information on to national web-portals, that little time and space was given to use of information. The feedback forms on this application were little used. The state level applications in Tamil Nadu, Rajasthan and Maharashtra were made by TCS, NIC and Ferguson respectively- but these did not have local analysis and feedback provisions.

   c. The district level planning exercise was weak and did not form the basis of resource allocation to the district and within districts. A robust district plan would have required robust information support. Given the prevailing culture of merely implementing vertical programmes, the need for decentralized planning was poorly felt and therefore the need for data and the culture of using data was never established.

   d. The needs of district level information that are useful for management decisions were ill understood. There is a need for the health information system to present and disseminate data in appropriate formats for different audiences. There is also a need to understand how to use data from HMIS and what information not to expect of HMIS. For example the progress on specific programmes e.g. SBA training programme would not flow through HMIS. In its present avatar HMIS is best used for tracking the access, volumes and quality of service delivery through the public health system.

   e. Capacity for data analysis is often lacking at peripheral levels where the data are generated and where the results need to be used for planning and management. Bringing together a comprehensive analysis of the health situation and trends with data on health inputs, such as health expenditure and health system characteristics, is particularly important. The development of such analytic capacity requires planning.

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Box 5A Building blocks of health information system

Data → **Information** → **Knowledge**

More often than not, the concepts of data, information, and knowledge are used interchangeably though they are not synonymous. Often collecting more data is treated as creating more knowledge which is a wrong assumption. This is in fact a key reason for the observation that health information system are not effective or adequately utilised. These concepts are defined as under:

Data: are raw material in the form of numbers, characters, images or other outputs that gives information after being analyzed. Data are these raw material without context.

Information: is a meaningful collection of data organized with reference to a context.

Knowledge: when information is analyzed, communicated and acted upon, it becomes knowledge.

If the system is designed primarily to support district and sub-district level decision making and a part of the information collected for this primary purpose flows up secondarily - as some sort of collateral gain- to the state and national level, then we have much higher likelihood of better data quality/ reliability and of the use of data in public health practice

In a context of greater decentralization of decision making to district, block and facility levels, increasing granularity of data supported by user friendly analysis and display tools available at these local levels would enhance the quality of decentralized decision making

Information Requirements and Design of HMIS

One of the most important elements of HMIS design- indeed the starting point, is to be able to conceive what is the information most useful at each level. This has to be articulated in terms of what information is needed for policy action, for monitoring implementation of the programme and for supporting management decision making.

The principle we establish is that *"if the system is designed primarily to support district and sub-district level decision making and a part of the information collected for this primary purpose flows up secondarily – as some sort of collateral gain- to the state and national level, then we have much higher likelihood of better data quality/reliability and of the use of data in public health practice."*

Where the emphasis of design is primarily on policy use and then secondarily for monitoring purpose and finally almost as an after-thought providing some space for district level analysis and use of information, the system is pre-programmed for failure. Not only will district level management use by minimal- the quality of data for monitoring and policy purpose will forever remain poor.

Further we make a postulate: *"Increasing the granularity of data- by asking for individual data or facility level data- would worsen the quality and use of information in the latter approach. However in a context of greater decentralization of decision making to district, block and facility levels, increasing granularity of data supported by user friendly analysis and display tools available at these local levels would enhance the quality of decentralized decision making."*

We leave these postulations open to further dialogue but move on to work out the use of information consistent with the first approach.

Information Use at National and State Level

Main uses of data at national level and state level

i. **Policy level decisions:** where (states, districts) are more or better health programmes needed for achieving the policy goals? Is the strategy working? Or do we need to invest more money, time in some areas or in some programmes?

   a. Information is required in terms of changes in major health outcomes and access to essential services. (e.g. perinatal mortality, OPD attendance or hospitalization per capita, under 5 mortality).

   b. Information required in terms of burden of diseases and changes in this. (mortality and morbidity data, utilization of some services could be indicative).

   c. Information required on cost of care. (currently not collected- except on public health expenditure).

ii. **Monitoring Function:** Are the districts doing their tasks? Are expected outcomes and outputs being realized- in terms of health outcomes, service delivery outcomes and in terms of programme milestones/activities. Which districts are lagging behind?

iii. **Management Functions:** Which districts require more funds? Which require more human resources or infrastructure? Which require closer supervision or capacity building or technical

Essential step in strengthening health information systems is to link data production to data use

assistance? Which programmes are behind schedules and needs support?

Most Useful National and State Level indicators are impact or outcome indicators. Some ouput indicators could also be required at this level:

Health Impact Indicators: Most useful for policy and evaluation:

1. Maternal Mortality ratio
2. Infant and under 5 Mortality rates
3. Neonatal mortality rates
4. Perinatal mortality rate
5. Malnutrition indicators
6. Low birth weight indicators
7. Sex ratio at birth, and at 0 to 6 age groups
8. Birth rate
9. Total fertility Rates
10. Age specific death rates
11. Income, gender, caste/tribal equity relationships to all above health indicators.

Except for 5, and 9 and 11 in the list above- all the other information can potentially be calculated from the current HMIS.

The Annual Health Survey, the census and the DLHS should remain the main sources of the above indicators for policy use at state and national levels

These indicators are useful for policy making and for impact and outcome evaluation. However due to problems explained earlier, the above figures when sourced from HMIS would have such gross under reporting as to be of very limited value. **Sample surveys are the most reliable source of information** for these indicators. When the above gross HMIS indicators are themselves unreliable even trying to use it for caste and class disaggregated data is futile. Out argument is that this is not a failure of HMIS- but inherent in the methodology and in the current design. It would be an error of understanding to use HMIS for these purposes. The Annual Health Survey, the census and the DLHS should remain the main sources of the above indicators for policy use at state and national levels.

Health programme outcome/output indicators

i. Institutional delivery rates
ii. Home delivery-non SBA rates- (unsafe delivery)
iii. Full Immunisation rates
iv. Measles Immunisation rates
v. Three ANC rate
vi. Newborns visited for home care rate

vii. Sterilisation Rates- relate it to expected level of achievement

viii. Spacing Methods couple protection rate

ix. Met Emergency obstetric care- and C-section rates

x. Malaria- API, PF rate

xi. RNTCP: treatment completion rate, case detection rate, death rates

xii. Leprosy: MBD fresh cases- fresh cases in children

xiii. Cataract surgery rate

xiv. AEFI rates and deaths due to immunization

xv. Sterilisation deaths and failures.

Note: Some of these could be termed output indicators as well- depending on how we construct the logical framework. If maternal mortality is the outcome, then institutional delivery is the output. If on the other hand we use maternal mortality rate as impact indicator, then institutional delivery rate is an output indicator. These are useful for assessing the outcomes of specific health strategies. They are also essential for management decision at district level.

For all of these above indicators it would be useful for districts to compute and send district indicator values- and not only the data elements which constitute the numerator of these indicators. Currently it is only the data elements which flow up and at national level indicators are calculated using population derived data elements for the denominator.

Health programme output/process indicators

The entire list of 77 data elements in the sub-center form and 270 data elements in the PHC format are currently converted to approximately 200 indicators and made available as a district HMIS report. These provide more details on volume of services given and some broad indication of quality of services given.

Ideally all the above indicators should be computed by the district and by the block and should be made available to the national and state level, instead of being computed at the national level Block level performance analysis, and facility level information is not essential at national level. Block level performance analysis is however essential at the state level so as to assess whether the districts are allocating resources to under-serviced areas, and to blocks and facilities where case loads are more. Block level analysis is needed to monitor district functioning- and prevent uneven development within the district. Facility level disaggregation is not useful or actionable at the state level- though large volume facilities like district hospitals could be monitored.

The data analysis reports for any district, or state level are available at the website – www.nhsrcindia.org

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There is a case for asking for this report only in terms of a performance score for each district- instead of asking for the raw numbers and trying to aggregate this at the national and state levels. Thus for each district we would be given the indicator score- for example the percentage of newborns breastfed in the first hour and not the number of newborns breastfed in the first hour. This would enable better monitoring by the center and better use of data at lower levels. As a compromise we can ask for both, but for districts to generate and upload only data elements as raw numbers without casting them as indicators is a fundamental design flaw that would always lead to poor use of information.

Data sources for national and state information needs

- Surveys
- Routine Monitoring Systems.

Surveys

External Surveys are conducted by independent agencies periodically, example of such surveys are:

1. Sample Registration System (SRS)-Birth Rate, Death Rate, IMR, Total Fertility Rate.
2. NFHS-III-2005-06-RCH service delivery data.
3. DLHS-III-2007-08-RCH service delivery data.
4. Annual Health Survey: similar to the DLHS-III but with a few more indicators, it is focused on 284 districts in the 9 high focus states of Assam, Bihar, Chhattisgarh, Jharkhand, Orissa, Madhya Pradesh, Rajasthan, Uttarakhand, Uttar Pradesh.
5. UNICEF Coverage evaluation survey - 2009.
6. NSSO-60th round-cost of health care - 2004–05.

Commissioned surveys and studies

Commissioned Surveys and Studies usually have some special purposes such as screening for chikungunya, dengue, or screening for malnutrition among children under five in a community, etc.

Use of information from surveys

a. Best used for policy purposes.

b. Also essential for accountability functions-especially for national and state departments/ministries for replying to legislature; planning commission, cabinet and various institutions at the national level reporting to these which are meant exclusively for accountability- CAG and PAC, standing committee and estimates committees and other parliamentary committees.

c. For better allocation of resources at national and state level.

d. For triangulation of district level data from external surveys with HMIS data and thereby validate the latter data set for better use at district and sub-district levels.

Strength

High perception of reliability Issues.

Limitations

- Information available only after a significant time lag. Limits its use in management- and even for monitoring- accountability function.
- Does not have mortality data.
- Dis-aggregation to facility/block level not available- and since these are essential for district planning. Except for DLHS others do not even have district level data. Limits use for management purpose.
- Limited number of parameters.

Data from routine monitoring systems

- Health Mangement Information Systems- under RCH-NRHM.
- Integrated Disease Surveillance Programmes (IDSP)-other communicable disease, disease outbreaks.
- NVBDCP information system: Malaria-by state, district and even by facility; Other VBDs-disease prevalence.
- RNTCP information system: Tuberculosis-case detection rates, cure rates, death rates.
- Leprosy-new MB cases and cases in children.
- Hospital Data- from hospitals that maintain reasonable case records.

Strength

Great tools of decentralised programme management.

Issues

- Each of these are stand-alone monitoring systems with inability to talk to each other.
- Perception of reliability-very low.
- Quality of data-varied needs interpretation to use.
- Design and applications not user friendly for management purposes. Information not available in easily accessible and usable form. Conversion to indicators and interpretation of data very weak. RNTCP however has a robust indicator based system.
- Clarity on what information would be most useful for and for what purpose, is weak.

HMIS data is a reliable source of routine data for use in programme monitoring and management support- though not for policy. For management purposes, despite data quality issues, HMIS data is more useful than any other existing source of data, as information could be interpreted in context.

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Information Needs for District Level Programme Management

Introduction

Traditionally in India, planning had been done at "higher" levels i.e., National or State. Under NRHM, there was an effort to give the concept of decentralized planning more meaning and substance.

HMIS plays a crucial role in this. HMIS makes available analytical tools that can generate graphs and charts which can be easily used by healthcare workers at Districts and Blocks. Such analysis makes information more "visible" and meaningful to local staff, who can be encouraged to use every available opportunity to discuss information at meetings, during supervision, in-service training and most importantly in making Block Health Plan and District Health Action Plan.

HMIS is the ***only*** available information source and an effective tool of decentralized district programme management. This includes both district planning and monitoring. The DLHS is infrequent, available after a large time gap and only yields aggregated district data. Intra-district variations between blocks and facilities which are essential for district level management cannot be obtained from these surveys. The Annual Health Survey may make data available more frequently- but will still not provide the disaggregation that is essential for any meaningful district health management. The DLHS and AHS would thus be useful tools of concurrent programme outcomes evaluation- as against the HMIS which would remain the prime tool of planning, monitoring and management. One important role that DLHS and AHS would play is as a data source for triangulation with HMIS data to validate the latter, and build confidence in HMIS data.

HMIS data at the district and sub-district -district level could be used for 6 objectives:

1. Understanding Access to Healthcare
2. Case load Distribution across facilities
3. Range & Quality of Delivery of Services
4. Outreach services
5. Community level intervention
6. Health Outcomes

Use of information at district and sub-district levels

HMIS data at the district and sub-district -district level could be used for 6 objectives:

1. **Understanding Access to Health care:** especially the public health system: This has implications for development of new facilities, for planning health education to communities, planning efforts to overcome social or geographic barriers to access. It may also indicate the need to improve functioning of health facilities in that area.
2. **Case load Distribution across facilities:** This is essential information for planning infrastructure development and human

resource deployment. Facilities with large case loads may require more funds, more beds, more human resources and more untied funds for maintenance and supplies. District hospitals with too large a case load of normal deliveries may need to be de-pressurised by developing more peripheral facilities in the hierarchy. Minimal case loads where access was also low may call for more investment of funds and support for facility development.

3. **The Range & Quality of Delivery of Services:** Facilities of each category – district hospital, CHC, PHC etc are expected to provide a certain range of services with a certain level of quality. These are specified in the Indian Public Health standards and also required under different programmes like the RCH programme, the AIDS control programme, the RNTCP etc. If a facility is not providing the entire package of services expected of it there is a gap- usually in skills or supervision, but could also be due to human resources or equipment or supplies. At any rate it always calls for action. For example a facility which is providing emergency obstetric care is not providing safe abortion services- though it is meant to provide both and equipped to provide both. The other dimension is quality of care. A number of indicators which overlap with what could be called range of services measures the quality of care. These include the management of complications in obstetrics, the identification and treatment of anemia, the availability and use of laboratory facilities etc.
4. **Outreach Services – Achievement by Block/Sector:** There are important outreach goals- the achievement of full immunization, the achievement of full ANC checkups, the achievement of adequate post natal care, of adequate contraceptive prevalence rate/couple protection rate etc. Achievement on these parameters needs to be assessed for each sub-center. Even where there is potential universal access as evidenced by even one antenatal check up or one immunization dose, the reasons for the inability to deliver the full package of services with necessary quality must be identified and acted upon.
5. **Community level interventions:** This includes both the indicators related to functioning of ASHAs and village health and sanitation committees, but also those indicators directly associated with behavior change and changed health care practices.
6. **Health Outcomes - Mortality, Sex Ratio, Low Birth weight, etc:** This is similar to the use at national and state level with the difference that deaths and ratios are presented in absolute numbers and not as rates. Also the geographic scatter of this is important. At the district level this is most useful to improve the quality of death reporting as also act on any clustered deaths as also get death reviews done as a routine.

Minimal case loads where access was also low may call for more investment of funds and support for facility development.

where there is potential universal access as evidenced by even one antenatal check up or one immunization dose, the reasons for the inability to deliver the full package of services with necessary quality must be identified and acted upon.

HMIS Data is an excellent tool to identify the unserved population.

1. Use of HMIS data for assessing access to care

a. The gap between what is reported and what is expected… indicates those not reached.

HMIS Data is an excellent tool to identify the unserved population. The gap between the reported data and the expected data indicates the size of unserved population.

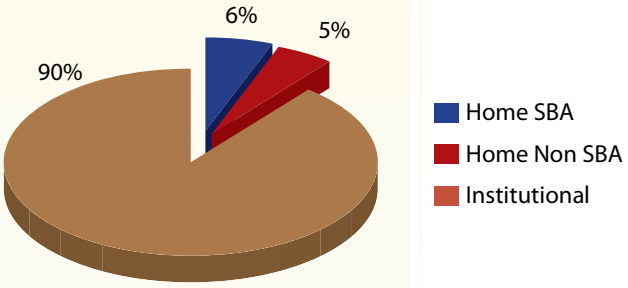
Table 1: Muzzafarpur 2009–10 HMIS data	
Total Population	**43,04,074**
Expected Deliveries	**1,30,444**
Home SBA Deliveries	2,217 (2%)
Home Non SBA Deliveries	1,976 (2%)
Institutional Deliveries	35,941 (28%)
Total Deliveries Reported	40,134 (31%)
Unreported Deliveries	90,310 (69%)

Example 1. As it is evident from Table 1, in Muzafarpur total number of reported deliveries is 40,134 while number of expected deliveries in the District is 1,30,444. 69 percent of unreported deliveries indicate the percentage of pregnant women who are not able to access the services for delivery.

Note: We should know by enquiry into the district context whether this non-reporting is due to private facilities from which data is not collected.

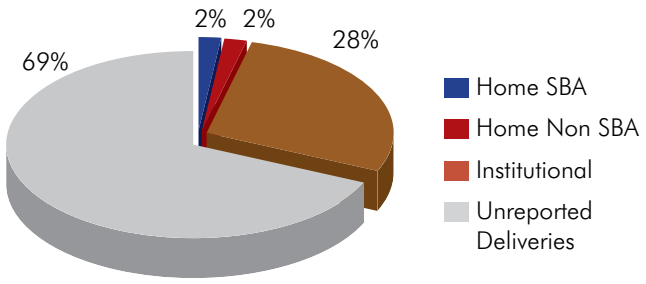
GRAPH A

Bihar - Muzzafarpur - Home (SBA Non SBA) Institutional Deliveries against reported deliveries - Apr'09 to Mar'10



GRAPH B

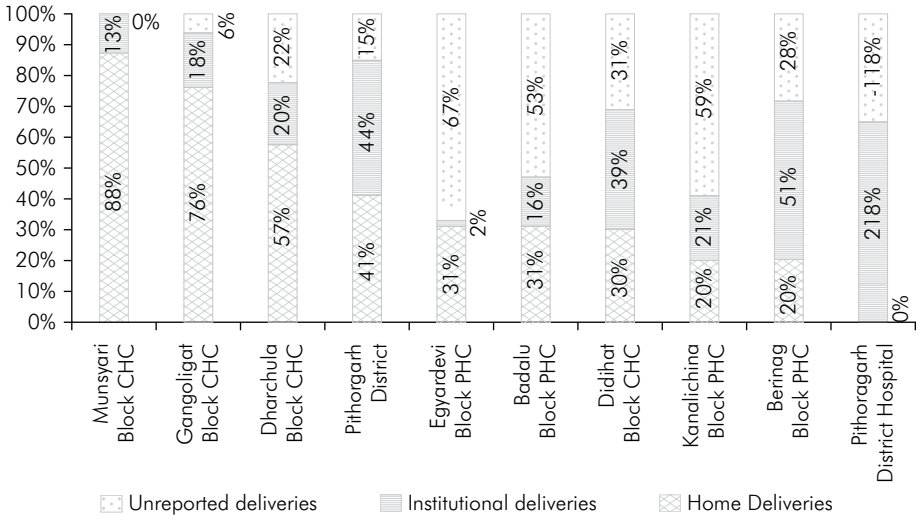
Bihar - Muzzafarpur - Home (SBA Non SBA) Institutional Deliveries against expected deliveries - Apr'09 to Mar'10



Example 2. With block and facility level data analysis we could disaggregate the non-reporting across blocks and even lower down to sectors or facilities. This would help us identify villages where some sections of people are are having problems in access to these services.

- Data of Pithoragarh district shows delivery case load distribution across facilities.
- It is apparent from the Figure that, maximum numbers of institutional deliveries are happening at Pithoragarh District Hospital. In Egyardevi

Uttarakhand - Pithoragarh Dist. Block-wise delivery status against estimated deliveries (2009–10)



block institutional deliveries were only 2 percent, 31 percent deliveries were at home, and 67 percent were unreported. The reason for minimal institutional deliveries in Egyardevi block is its proximity to DH.

- In Munsyari Block institutional delivery rate is low and home delivery rate is highest (unreported deliveries = 0). It is evident that Munsyari Block population is unable to access the institutional delivery services.

Though institutional delivery rates are low in both the Blocks, only Munysari Block CHC needs strengthening for physical access for the reasons stated above.

Further examples of such indicators of access are:

- percent of pregnancies receiving any ANC against expected no of pregnancies.
- percent of pregnancies receiving three ANCs against expected number of pregnancies.
- percent of children received any immunization versus expected number of children to be immunized.
- percent of home deliveries- SBA + non SBA.
- percent of home deliveries- non SBA (a higher level of lack of access).

b. Decline in reach is also a good indicator of access- and the determinants of this may be different from the determinants of the former type of gap:

- BCG to DPT 3, BCG to measles; DPT 1 to DPT 3
- First ANC to third ANC.

The district HMIS system should generate a feedback report with respect to blocks and another report with respect to facilities within a block in the form

The district HMIS system should generate a feedback report with respect to blocks and facilities in the form of a table- preferably ranked from best access to least access

Determinants of poor access would be geographic distances, private sector presence, social barriers and non functionality of facilities.

of a table- preferably ranked from best access to least access. The important requirement for this report is to have the denominators in the database to generate the denominators for "expected" or target achievement.

Determinants of poor access would be geographic distances, private sector presence, social barriers and non functionality of facilities. To express the relevant determinant a blank remarks column in the feedback form could be provided for manual filling up by the Data analysis team.

Patient and sustained follow up action would be required to find the sections of the population who are getting missed out.

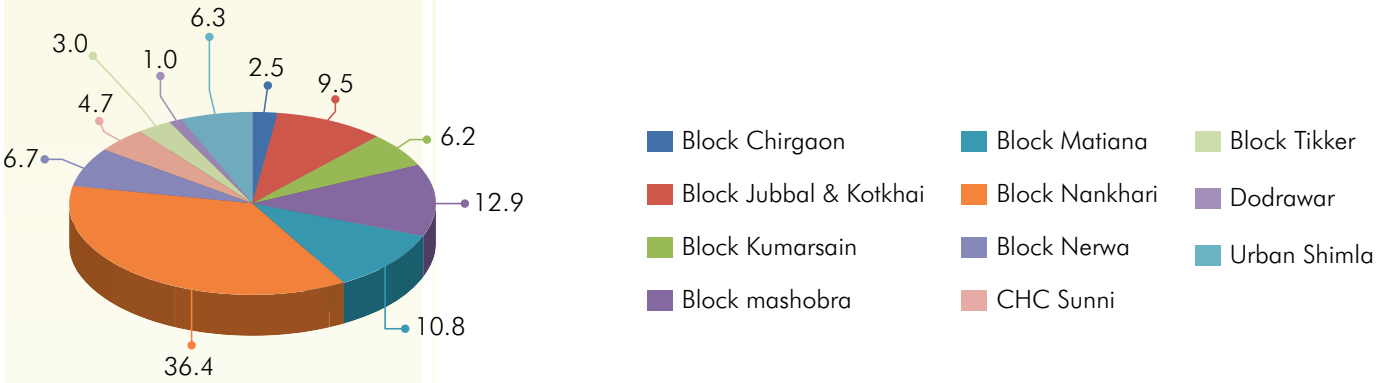
2. Use of HMIS data for - case load distribution across facilities

- The output needed is a block –wise, facility wise list of number of outpatients seen and in patients seen in each block and in each facility. This is useful for management action, irrespective of denominators. See example 3 below. Such a list could also be generated for specific services delivered for each programme - institutional delivery services, sterilization services etc.

Example 3

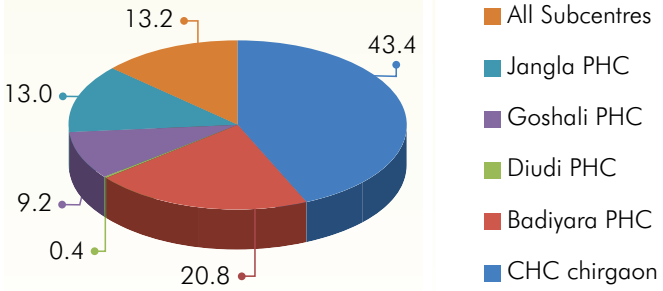
GRAPH A

District X - % of OPD cases - July'2011



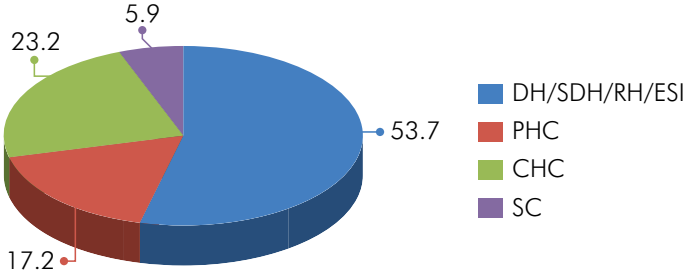
GRAPH B

Block A - Percentage of OPD cases



GRAPH C

Facility category wise - % age of OPD case



It would be useful to compare case loads seen by each facility with available nurses and doctors and population served or number of beds in one table. See example 3 above.

Example 4: Caseloads in proportion to beds and nurses and population served

Name of CHC/Block PHC	Population served	Total monthly OPD	Total monthly IPD *	Total no of beds	Total no of doctors	Total no of nurses
Block PHC A	120,000	3600	150	10	2	3
CHC B	240,000	6000	600	30	6	5
Block PHC C	180,000	6000	240	6	2	3
Block PHC D	180,000	4200	240	15	4	3

* Expressed as the sum of daily midnight head counts over a month.

From the above table we could calculate the following for each facility:

	Block PHC A	CHC B	Block PHC C	Block PHC D
OPD per capita per year	0.36	0.30	0.40	0.28
IPD as % of OPD	4.16 %	10%	4.0%	5.7%
Bed Occupancy rate	50%	67%	133%	53%
OPD/doc/ (25 day-monthly)	72	40	120	42
Monthly IPD per available nurse	48	48	78	78

This sort of analysis is very useful to take decisions on where to add beds, where more doctors or nurses is needed, where more work is needed on increasing utilization, where more untied funds are needed etc.

Example 5: Programme Specific Case loads distribution by block and by category of facility:

- One could also take the burden of disease or the total service delivery for a specific service and map the distribution of service delivery across blocks and across facility types. This is shown in example 3 below with institutional delivery as the example.
- The case load of facilities and the problems of access could also be analysed together as discussed earlier to understand the problems of low utilization better.
- List of sub-centers reporting institutional delivery, reporting home deliveries and reporting home SBA delivery is also needed with case-loads noted and if possible, the population served by each.

Apart from volume of cases seen, by using well chosen indicators one could also comment on quality of care

3. Use of HMIS data for - the range & quality of delivery of services

HMIS data provides the details of the antenatal care, delivery, postnatal care, immunization, and family planning services. This could be extended to other programme areas as well. Other than volume of cases seen, by using well chosen indicators one could also comment on quality of care. There are many ways of doing this:

a. One approach is to generate district level aggregate figures for all the complications managed or the range and proportional frequency of services provided in a district. This indicates the total district

capacity to provide these services and one can compare this against the expected need for these services.

Example: Below are annual HMIS reports on institutional deliveries and the range of complications managed and related RCH services from two districts.

Reported Deliveries	125497 (91%)
C-sections	4355 (3%)
Other Compl. pregnancies	4244 (3%)
PNC complications	16019
Still births	1501
Iv antibiotics	1237
Iv hypertensive	86
Iv oxytocics	1137
Blood transfusion	65
severe anemia treated	1304
Abortions managed	2156 (2%)
RTI/STI- per lakh OPD cases	33508(810)
South 24 Paraganas-west Bengal	

Reported Deliveries	37689 (91%)
C-sections	10219(27%)
Other Compl. pregnancies	11602(31%)
PNC complications	2
Still births	121
Iv antibiotics	11938
Iv hypertensive	241
Iv oxytocics	1343
Blood transfusion	157
severe anemia treated	99
Abortions managed	1963(5%)
RTI/STI- per lakh OPD cases	5838(150)
Pallakkad – Kerala	

Zero list is the list of facilities who are supposed to be providing these services as per the plan, but who in reality are not providing these services. Useful to assess the range and quality of services

It is apparent from above Table, that South 24 Paraganas district facilities are not conducting C-section deliveries and are not having the capacity to attend to complicated pregnancies.

b. Another, very useful approach is to generate the " Zero List". This is the list of facilities who are supposed to be providing these services as per the plan, but who in reality are not providing these services. It is most useful if HMIS generates the following lists of facilities in response to specific queries related to the availability of services. Lists need to be generated only for facilities where the service is part of its service guarantees:

   1. Which facilities provide C- Section (one could also indicate in the list facilities that are fully equipped and staffed to do C-section but it did not).
   2. Which facilities report MTPs - safe abortion services.
   3. Which facilities have reported blood transfusions (one could also include which facilities are fully equipped to provide blood transfusion but did not).

4. Which facilities have reported treatment for severe anemia in pregnancy (to correlate with the earlier two indicators).
5. List of facilities not testing for anemia and/or which have not reported a severe anemia over one year.
6. Which facilities reporting institutional deliveries which also report managing obstetric complications- what is the facility level and block level met Emonc rate. (indicated availability of Bemonc).
7. List of facilities reporting institution deliveries which also do not report any use of any injectibles- antibiotics/anti-hypertensives and/or oxytocics (indicates whether skilled birth assistance is being practiced).
8. Which facilities report HIV testing - any/adequately.
9. Which facilities report laboratory functioning - any/adequately.
10. Weighing Efficiency and LBWs - facility wise.
11. Breastfeeding in the first hour - facility wise.
12. Sick children admitted for pneumonia - facility wise.
13. Facilities where women stayed for 48 hours after deliveries.
14. Facilities doing wet mount test.
15. Facilities identifying RTI/STI cases and treating them.

This is the sort of information that would actually be most useful for decision making and follow up and monitoring at the block and district level. But because the needs of district level management are not properly visualized, this dimension is missed.

An example to explain this: A district HMIS indicator shows anemia in pregnancy as 35 percent. This is low reporting- but this is happening because many sub-centers are not testing for anemia and therefore reporting zero. There is no immediate action that the district manager would take for this report of 35 percent anemia which he would not have taken if it was 45 percent or 15 percent. In fact there is no value addition over what he already knows from secondary data and no particular change it would make to the district plan he would have made anyway. However if the HMIS generates a list of facilities which are reporting zero- and identifies thereby those facilities not testing for anemia- there is an immediate action to take in terms of supplies and supervision to get testing started in these facilities.

c. One variant of the zero list, is the poor performance list. This is when the facility or block does not report zero as such, but is performing much poorer than what is expected. Here the basic equipment, HR and infrastructure are in place, but alertness to the issue and perhaps skills and motivation are deficient. One problem with such lists is that just a zero or not report is not enough. The facility may see a few

cases but far less than what is adequate. To compare the volume of specific services with respect to general case loads one may have to generate ratios- as in the example given below.

Table 2

	RTI/STI per lakh OPD	Male RTI/STI per lakh OPD	Female RTI/STI per lakh OPD
Jhirniya Block	8655	4668	3987
Barwah Block	1849	689	1160
Gogawa Block	899	445	455
Oon Block	591	218	373
DH Kharagone	154	25	129
Bhagwanpura Block	154	79	75
Maheshwar Block	50	19	31
Kasravad Block	47	19	28
Segoan Block	27	0	27
Bhikangoan Block	0	0	0

There is no such standard indicator called number of RTI/STI per 100,000 Outpatients- but clearly such an innovation in analysis makes a big difference to use of information

Clearly there is either a very different awareness about testing for RTI/STIs across facilities/blocks in the same district. It could be that some blocks have a greater local reputation for this service in a few facilities. Or there is an epidemiological pattern of high transmission in one area that cries out for preventive action. There is no such standard indicator called number of RTI/STI per 100,000 Outpatients- but clearly such an innovation in analysis makes a big difference to use of information.

4. Use of HMIS for assessing outreach services – achievements by block/sector and by sub-center

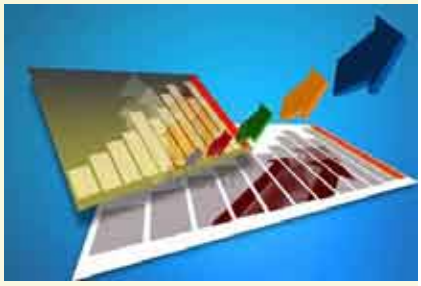
Below is the list of outreach services indicators which can be calculated from HMIS data. This needs to be done for every block and for every sub-center. At the sub-center level instead of expressing it as percentages one may give both numerator and denominator as numbers.

A block manager could use these indicators as available for each sub-center to prepare a list of sub-centers and against each sub-center they could write down what is area of programme performance needs to be strengthened. Where many areas of programme performance in a block or in a sub-center are poor, there must be underlying structural or contextual problems that should be enquired into and action taken.

ANC quality indicators: range of services provided

We note that we have earlier discussed ANC registration against expected pregnancies- that is part of access to services. As different from that indicator, the indicators below use the reported ANC registration as the denominator, and the indicator therefore relates to quality of care in those who have accessed services:

- ANC Registration in first trimester against Total ANC registration
- 3 ANC Checkups against ANC Registrations
- Percent of women who got TT2 or booster against ANC Registration
- 100 IFA Tablets given to Pregnant women against ANC Registration
- Hypertension cases detected against ANC registration/three ANC
- Percentage of ANC moderately anemic (Hb<11) against ANC registration
- Percentage of ANC severe anemia treated (Hb<7) against ANC registration.



Postpartum care indicators

These are weak indicators of PNC, but currently this is what is available in HMIS:

- PNC within 48 hours as percentage of reported delivery
- PNC between 48 hours to 14 days as percentage of reported delivery.

Immunization indicators

All of these indicators given below are also indicators of access to services because denominator is expected live births. However when compared to either live births or babies given BCG, it could become an indicator of how good ANMs follow up (nowadays referred to as tracking) is:

- BCG given against Expected Live Births
- OPV3 given against Expected Live Births
- DPT3 given against Expected Live Births
- Measles given against Expected Live Births
- Fully Immunized Children against Expected Live Births- by sex and totals.

Process indicator for immunisation and antenatal care

- Percentage of immunisation sessions held against planned
- Percentage of immunisation sessions attended by ASHA against sessions held.

These are some of the most important indicators for use in district planning and management, with immediate action possibilities. But for this, the number of sessions planned must be the same as the number of sessions required. And the number of sessions required should be worked out by mapping – and ensuring that there is a center for every habitation, for every anganwadi center and for every 1000 population-whichever is less. The percent of immunization sessions attended by ASHA is a crude indicator of ASHA functionality.

	Population	Immunization Sessions Required	Immunisation Sessions Planned	Immunisation Sessions Held	Immunisation Sessions Attended by ASHAs
Ratlam District	1036272	16046	11857	11502	8979
Billpank Block	282266	3387	2334	2334	2334
Kharwa Kala Block	194926	2339	2158	2148	1810
Bardiagoyal Block	172092	2065	2144	2025	1392
Sailana Block	120730	1449	1735	1634	1128
Piploda Block	144266	1731	1386	1386	1018
DH Ratlam	277690	3332	1280	1176	928
Bajna Block	145156	1742	820	799	369
NB: No. of Immunisation sessions required- could be by 1 per 1000 population calculation, or by one per Anganwadi center – further corrected by mapping to factor in distant hamlets etc.					

Family planning

- All Methods Users (Sterilizations (Male &Female)+IUD+ Condom pieces/72 + OCP Cycles/13) as percent of eligible couples
- Sterilizations done as percent of the unmet need for sterilizations
- IUD insertions as percent of beneficiaries using any FP method
- IUD insertions last year as percent of unmet need for spacing OR as percent of women who delivered within the last year, their first or second child
- Percentage of Condom Users against reported FP Methods as percent of unmet need for spacing
- Percentage of OCP Users against reported FP Methods or as percent of unmet need for spacing.

The unmet needs could be calculated from what is known as a community needs assessment survey or it could be derived from the unmet need for spacing and limiting as available for the district level from the DLHS or annual health surveys.

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5. Use of HMIS data for managing community level interventions

Most community level interventions aim to bring about changes in health behaviours or health care practices. These could be through various forms of health communication and community mobilization. The major programmes that are part of the National Rural Health Mission are the ASHA programme, the Village Health and Sanitation Committee and the behavior change communication programmes.

Process indicators

Monitoring of the ASHA programme at the block level is based on a a set of indicators collected by ASHA mentor-facilitators from the ASHAs during their monthly meetings and which relates to ASHA functionality. These are not present in the district software – and this information flows manually. It includes:

1. ASHAs who visited newborns in the first day and completed a set of 6 visits to newborn
2. ASHAs who are active in providing care for children with diarrhoea, ARI and fever
3. ASHAs who are attending immunization session/VHND and mobilizing beneficiaries to attend this
4. ASHAs promoting institutional delivery/accompanying women for delivery
5. ASHAs who have made successful referrals of those needing IUD or sterilization services. (they would know the unmet need in their area)
6. ASHAs who are making regular household visits- including nutrition counseling. (they would know the children who are malnourished by grade of malnutrition in their area)
7. ASHAs who conducted/attended a VHSC or other village meeting in the last month
8. ASHAs who are active as DOTS provider
9. ASHAs active in making slides/using RDK/giving drugs for malaria in fever cases
10. ASHAs active in at least 5 of the above nine activities- fully functional ASHAs.

At the block level we consolidate the report in terms of percent of ASHAs functional on each of these nine activities and the last of these- as the percent of functional ASHAs in the block. Above the block it is adequate if only the percent of functional ASHAs in that block is reported or blocks be graded into level of performance and only this be reported.

Output indicators

There are many output indicators that relate to ASHAs work or patterns of community involvement and behavior. These indicators are primarily indicators of facility or outreach performance and depend on a number of activities. The inputs from community processes is only one of the contributory factors to these outputs. However by linking these outputs to community process indicators, one could get a sense of the contribution made by these community processes. This is illustrated in the table below.

Monitoring of the ASHA programme at the block level is based on a a set of indicators collected by ASHA mentor-facilitators from the ASHAs during their monthly meetings and which relates to ASHA functionality.

ASHA Programme Indicators

Output indicator in HMIS	**Process Indicator –** Some are available on HMIS. Most are collected at block level by facilitator. These help to understand ASHA functionality	**Data source and frequency**
Percent of Institutional delivery+ percent of home SBA delivery	JSY payments ASHA	HMIS
	Proportion of pregnant women who had a birth plan	ASHA divas/ monthly
	Proportion of pregnant women who were streamed appropriately for a complication	ASHA divas- monthly
Percent of pregnant women who received three ANCs	Immunisation sessions attended as percent of sessions held	HMIS
Quality of ANC-cases of HT detected, anemia detected, severe anemia treated		HMIS
Percent Newborns Breastfed in first hour	Percent of newborns visited by ASHAs - within first day	HMIS + AD
Percent of LBW	Percent of newborn weighed in the last month	HMIS + AD
Percent of newborns referred/ admitted as sick	Percent of newborns who received full complement of visits Percent of newborns referred as sick	HMIS + AD
Percent of children admitted for ARI Percent of children severe dehydration in diarrhoea	Percent of children with diarrhoea who got ORS Percent of children who got appropriate care for ARI Percent of children or pregnant women with fever for whom testing was done	HMIS + AD

Output indicators which are largely a measure of the effectiveness of ASHA

	Live Births	Breastfeeding in First Hour	Birth Weighed	Percentage of Breastfed in First Hour	Percentage of Births Weighed
Niwas Block	1203	857	810	71%	67%
Nainpur Block	2892	2302	3321	80%	115%
Bichhiya Block	3919	1528	2650	39%	68%
DH Mandla	408	0	408	0%	100%
Bamhani banjer Block	3169	2602	2266	82%	72%
Mohgaon Block	1633	1116	1435	68%	88%
Narayanganj Block	1368	1115	1245	82%	91%
Mawai Block	1604	404	713	25%	44%
Ghughari Block	2007	1767	1794	88%	89%
Bijadandi Block	1373	1045	1375	76%	100%

The indicators would have to be generated block wise.

JSY indicators

As an activity aimed to change the nature of health seeking behavior, the performance of JSY is discussed in this section. The main output indicator is institutional delivery- and to some extent quality indicators of ante-natal and post natal care.

The main process indicators currently available are JSY incentives paid to mothers as percentage of reported delivery, dis-aggregated for:

- Home delivery
- Institutional delivery (public)
- Private institutional delivery.

VHSCs

This is a major component of community participation. The output indicators would depend on what the activity of the VHSC is focused on, and there is not as present sufficient clarity on this. There is also the larger question on whether such standardization is desirable. As a result the only indicator available is the number of VHSCs that have submitted Utilisation certificates for the untied fund they received. This could be consolidated and presented block wise.

6. Use of HMIS data for measuring health outcomes: mortality including still births, sex ratio, low birth weight and malnutrition rates

Health outcome indictors are best seen when aggregated for a district. Sub-district calculation of rates could be misleading since the numbers are small. Mortality rates are one of the most readily available and most widely used health outcomes indicators.

However when using the mortality rate from HMIS in district planning and programme management we need to carefully re-define how we would use this data. The purposes of looking at mortality reporting is:

a. To ensure completion of maternal and under 5 child death reporting. One could also feedback mortality reports to community to fill gaps in the reporting. In a standard North Indian district of about 20 lakh population with MMR in the 300 per 1 lakh live births range, we expect over 10 maternal deaths and about 100 infant deaths every month. We currently get very few reports of such death. Getting all deaths reported is the first goal. Ideally those districts not reporting deaths or reporting much less than the "apprehended" number of deaths should be investigated and non-reporting should attract disciplinary action. Triangulating the information on deaths which we

Getting all deaths reported is the first goal. Ideally those districts not reporting deaths or reporting much less than the "apprehended" number of deaths should be investigated and non-reporting should attract disciplinary action

States without a support software of their own, who are dependent only on the national web-portal would have to struggle to do this analysis manually or on excel sheets. But do it they must- for it is well worth the effort. Also without this effort, all the time and labour spent in collecting and sending up so much of data is wasted

have with what the registrar of births and deaths has recorded will also help locate sources of underreporting.

b. Whatever is reported is likely to be a representative sample and we can still study the main causes of deaths. One could also ensure maternal and infant death reviews and verbal autopsies of every death reported so that we get a good idea of the causes- epidemiological, programmatic and social behind these deaths. The challenge is to get both a grasp of the clinical and the systems related causes for these deaths.

c. To improve the quantity and quality of *all* death reporting. This too requires both improving information flows on this aspect and training of service providers.

d. Sex ratio at birth should be at about 950 girls per 1000 boys without sex selective abortions. Much lower sex ratios is a cause of alert and need for local action.

e. Low birth weights and still births are sensitive and holistic indicators of maternal health and even facility level incidences provide clues to action needed to improve maternal health.

Thus we can see that the whole purpose of data analysis and the nature of information needed at the sub-district level and for district level management is very different from what state and national capital needs. Unfortunately states without a support software of their own, who are dependent only on the national web-portal would have to struggle to do this analysis manually or on excel sheets. But do it they must- for it is well worth the effort. Also without this effort, all the time and labour spent in collecting and sending up so much of data is wasted.

Measures to Improve Use of Information

One of the most interesting and useful ways of promoting use of information is having sessions called "conversations over data" when the data is presented to the group of programme mangers or HMIS managers and a discussion is set off as to the validity and the utility of the data. This leads to both improved data quality and the use of data

a. Institutionalize regular feedback in every level of HMIS aggregation- and make sure that the information is actionable and supportive of management interventions to improve programmes.

b. Invest time and effort in developing feedback forms in consultations with programme managers. Study what actions programme managers would take if they had the information needed and what inputs district planning needs. Based on this shortlist the indicators that would be presented and the way they would be displayed and provided to the programme manager so that it makes it easy for them to act on it.

c. Build systems- software, computers, manpower, skills- to analyse data and use it at the local level.

d. Display analysed information prominently in facilities and offices.

e. Disseminate analysed information to all potential users- spend on making adequate copies for distribution.

f. Actively promote use of information for planning and monitoring. One of the most interesting and useful ways of promoting use of information is having sessions called "conversations over data" when the data is presented to the group of programme mangers or HMIS managers and a discussion is set off as to the validity and the utility of the data. This leads to both improved data quality and the use of data.

Review Questions

Q1. What are the reasons identified for the sub-optimal use of available information today?

Q2. How would you use the existing HMIS data to explore access to care and exclusion of sections of the population from public health care?

Q3. Current HMIS information is very useful for district health management – but very limited use for policy decisions and reporting/ accountability at national levels. The latter is dependent on periodic surveys like DLHS-III. This trend is likely to continue and perhaps is even inevitable? Do you agree? Discuss.

Q4. What are the main purposes for which currently available HMIS information can be used at district and sub-district level?

Q5. What are data sources available and in use of policy purposes and state and national level. List the surveys and the strengths and limitations of each.

Q6. What are the different health information systems in public health management- that are currently in use ? What is the degree of synergy between these systems.

Q7. Most data elements in HMIS relate only to service delivery. But a few relate to health outcomes? Could you name these?

Q8. Suggest a set of measures to improve the use of information?

6 Data Triangulation, Factoring in the Community and Measuring Health Equity – Unfinished Agenda of HMIS Reform

In this chapter we shall learn:

a. The concept of data triangulation and the possibilities and uses of such triangulation.
b. How to gather information related to equity concerns for both policy and management issues.
c. How to involve communities and capture community perceptions/knowledge as sources of information in HMIS system, and as users of information.

Introduction

When a process of HMIS reform was initiated under NRHM, the problems of data quality were anticipated. The solutions offered were data triangulation and a role for community monitoring. In practice neither of this was systematically or consistently attempted- at least as form of improving data quality in HMIS. Part of the reason was that maternal and child tracking suddenly emerged as the main strategy of improving data quality. It is not for us to wonder on why it did so. What we are trying to document in this lesson- is the path not travelled- and the challenges that it posed and the potential it had… and still very much has, to improve data quality and the use of information.

Another major founding argument was the requirement to collect date disaggregated for economic status, urban-rural divides, SC/ST and OBC status, and perhaps even minority community status. Such data collection was largely deferred- as it was pointed out that it increased the burden of reporting greatly without increasing use of information. Also at a time when even the basic data lacked in reliability, collecting data with so much disaggregation would compromise data quality further. However five years down the line, there is a need to revisit the debate and reassess which of the old arguments are still valid and what new possibilities have opened up. For there is no denying that one of the most important aspects of a public health information system is to provide data with respect to health equity.

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Data Triangulation in Public Health – a Brief History

Public health professionals are well aware of the complexity and multifaceted reality of their subject matter. Since every data source has certain strengths and limitations each source is by itself insufficient to capture the trends and details of the situation. Yet data from diverse sources are rarely presented together, since gathering/accessing, synthesizing and interpreting them is quite challenging. One way of overcoming the disadvantages of various data collection methods and enhancing the accuracy (and depth) of data is through the combination of data collected using different methods.

Triangulation is a term that can broadly refer to an approach to synthesizing multiple sources of data/information at the level of interpretation

Triangulation is a term that can broadly refer to an approach to synthesizing multiple sources of data/information at the level of interpretation. The term triangulation is derived from surveying and navigation, where it refers to finding a position – a fixed point – by getting bearings on different objects or points of reference. In this context of data validation, it refers to methods for establishing both internal and external validity and decreasing the uncertainty of a single measurement by making multiple observations. Social scientists have used the term "triangulation" since 1960s. The methodological use of the term is usually traced back to a 1959 article by Campbell and Fiske. Although there is no universally accepted definition of data triangulation, it tends to refer to combining the results of complementary methods in order to get more accurate result. Campbell and Fiske refer to ''convergent validation''. This is a simplification, however, and in the literature on social science research methods there has been heated discussion about what triangulation is and is not, and whether it is possible at all. Basically, the controversy revolves around epistemological issues: whether, in the social realm, there is a ''fixed point'' at all, and whether the fact that method A agrees with method B makes either method more valid.

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These issues are relevant for a number of reasons. First, while we do not take a "relativist" position relating to the ''truth'' of the behaviors we are studying, it is clear that this truth is of a different order to the ''fixed point'' of the surveyors and navigators, and most of the key behaviors that we try to measure are ambiguous and difficult to define. Second, convergence does not necessarily mean truth: if we collect data on, say, sexual behaviour using different methods and the numbers are the same, this does not necessarily mean that this is what ''really'' happened. It may be that the same bias and problems are shared in all the methods used.

What is Triangulation?

Definition: Public health triangulation is a process of reviewing and interpreting existing data and trends from multiple data sources on different facets of a broad public health question in order to identify factors that underlie the observed data and to assist with public health decision making and actions.

There are five guiding principles of public health triangulation:

1. Data abstraction/extraction or cross-matching between data sets
2. Synthesis of qualitative data (similar to narrative review) in contrast to combining data sets quantitatively for statistical analysis
3. Inclusion of diverse data sources, such as surveillance, research, programmatic and expert opinion; both quantitative and qualitative data; and both biological and behavioral measures
4. Input from stakeholders for the formulation of a public health question, data identification and assessment of data, interpretation and dissemination of results
5. Using results to inform public health decision making.

Triangulation does not formally demonstrate causality in the same manner as a purposefully designed randomized controlled trial but rather offers a rational explanation or interpretation of the data at hand.

What Triangulation is NOT

Given the diverse uses of the word "triangulation" and its broad applicability, it may be useful to say what public health triangulation is not. First, it is not conventional meta analysis. Meta-analysis combines methodologically similar data sets with similar outcome and predictor variables at level of statistical analysis, whereas public health triangulation examines methodologically dissimilar data and whether they corroborate each other. Secondly, public health triangulation is not a systematic review of the published literature. In addition to quantitative and qualitative data sources, it involves extensive searching of the unpublished reports

Difference between public health triangulation and conventional epidemiological analysis:

Public health triangulation analysis	Conventional epidemiologic analysis
Inductive, empirical	Deductive
Emphasis on 'best possible' existing data	Emphasis on data of highest scientific rigor
Focus on plausibility as basis for conclusions (with or without statistics)	Focus on statistics as basis for conclusions
Focus on external validity: "Can observed effects be generalized to the larger population?"	Focus on internal validity: "Did A cause B in our study?"
Based on inter-connected pieces of the same situation	Based on independent samples
Qualitative interpretation	Mathematical modeling
Goal: public health decision-making	Goal: increasing scientific knowledge

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- It is not conventional meta analysis
- It is not a systematic review of the published literature
- It does not involve primary data collection

and uses programmatic data, unpublished data sets and expert opinion or community feedback as well as published studies, meta-analyses and systematic reviews. Thirdly, public health triangulation does not involve primary data collection. Fourthly, it is also not a method to evaluate the performance of a newer data gathering method against an established "gold standard". Finally, it is a not a technique for rapid assessment.

Some scientists propose to triangulate methods/sources that follow different paradigms, e.g., medicine, history, and commerce Rorty (1991) suggests that more relevant details about society and people can be learned from literature than from approaches towards knowing reality that strive for purity of method (such as epidemiology). For example, Oliver Twist (Charles Dickens 1837-39) indeed provides rich information on underlying social causes of high childhood mortality in 19th century England - far more detailed than what could be learned in epidemiological studies, and certainly sufficient to support public health interventions. The familiar argument against using pieces of art as scientific evidence is that an artist's view is 'subjective'; researchers, by implication, would be 'objective'. Rosaldo (1993) believes that this subjectivity is actually an advantage. He argues that an individual, real-life phenomenon such as an illness can only be fully understood from a subjective position. A triangulation of epidemiological data and subjective observation would thus actually help avoid a superficial understanding of the reality of disease.

Data triangulation is beyond simple comparison of data, triangulation is used to develop a more composite and holistic picture, while at the same time accepting a necessary degree of uncertainty in the result. This is perhaps data triangulation's greatest utility. Triangulation is not a substitute to formal evaluations of interventions, carefully constructed surveillance systems, or formal monitoring and evaluation activities, but it does offer an opportunity to compare and contrast the data generated by these activities with the end of improving public health outcomes.

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Approaches to Data Triangulation

Denzin describes four types of triangulation:

a. Data gathered through different samples and at different times are compared; e.g. HMIS 2009–10 with DLHS-III.

b. Investigator triangulation, in which more than one investigator examines the same question and results are compared; ASHA evaluation studies done by NHSRC with that done by NIHFW and by International Advisory Panel on NRHM.

c. Theory triangulation, in which different theoretical constructs are applied to the same observed data; This is discussed later in the chapter on evaluation.

d. Method triangulation, in which phenomena are examined using different methods. Mixed qualitative and quantitative methods, often referred to as explanatory/nested model are used to explain complex phenomena.

Pragmatic approaches to triangulation at the district level

1. One of the most pragmatic possibilities for triangulation is the use of data from the most recent DLHS survey and the data from the HMIS reports for the district and from a third source- which could be a commissioned survey or it could be community monitoring reports, or it could be reports of a monitoring team making a visit of a sample of facilities as was done in the common review mission. This triangulation is best done for RCH services and maternal and child mortality, since there is rich data on this in all three sources.

   For example, the triangulation of reported data from service providers for immunization services is triangulated with data from 30 cluster sample surveys and with the consumption of vaccines from the stores to understand the true level of achievement in immunization. Though this is quite possible in immunization, it is not as easy for the others.

2. If the third apex of the triangle could be a sample survey, this brings far more depth to the discussion. However it is difficult and a duplication of efforts to do one more survey. It is more useful to use the data generated from some other study that one or other academic or research institution is doing. However rapid appraisal visits to a sample of facilities and villages is very instructive and tour reports of various officers are available. This could provide a very different type of data which could be used to understand reality in the district.

3. One data source for triangulation that has not yet been used- and this is an opportunity lost is the triangulation of data on births and deaths from the registrar of births and deaths, with reports of birth and deaths from healthcare service providers, and further triangulated with community through focal group discussions or informal enquiries of key informants. The least this would do is to improve the quality and extent of mortality reporting in all these three sources.

4. There are other sources of data like the consumption of certain drugs- e.g. anti-diabetics, or anti-hypertensives that could be triangulated with survey data and hospital data to arrive at conclusions about prevalence of these diseases. These have methods have not yet been used. In RCH services except for vaccines, no other drug or consumable consumption pattern lends itself to triangulation.

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One set of concerns raised about HMIS is the space it provides for the voice of the community to be heard or recorded

It is one of the goals of NRHM to empower communities and increase their participation in health care. To what extent has the HMIS design provided space to meet this goal

5. One form of organizing such triangulation which NHSRC tried in many states was to construct what was called "**conversations over data**". Thus data from DLHS and HMIS would be presented to an audience of programme managers and community representatives and there would be an active discussion on the picture of truth of the data presented. Community perceptions and inputs could be high in mortality, but did not necessarily comment on service delivery unless the figures were very off the mark. Community monitoring seldom had the systems to generate data that could be used for such perception. This is a serious design issue. On the other hand programme managers invariably had some parallel data set on their own which they relied on to interrogate the data presented to them. And often their interrogation could be convincing. These conversations over data led to a large number of actions- for improving data quality, for improving programme and for looking deeper at causative issues. In contrast presenting only one of these two or three data sets was never very convincing.

There has been a committee on triangulation formed at the national level under NRHM- but this is only for the national data set- and even this task was never completed:

> *The way forward is to train all HMIS teams at district and state level in data triangulation and then make this a part of regular planning to be done every year before the planning cycle begins- if not even more frequently.*

Community Roles in HMIS

- One set of concerns raised about HMIS is the space it provides for the voice of the community to be heard or recorded. HMIS specializes in aggregate numbers of service delivery and a few health events. Even this is compromised by the fact that it is largely the service providers who generates this information. But there are many aspects where the community may have a better knowledge of. What is the space in HMIS design to incorporate the voice of the community? Can a system be truly responsive to peoples needs if there is no space for the community voice?
- It is one of the goals of NRHM to empower communities and increase their participation in health care. To what extent has the HMIS design provided space to meet this goal? Can a system be truly accountable to communities if there is no space for the community to be able to read the information in HMIS and act on it?
- Does the HMIS even try to capture the functioning of community processes adequately. In practice there are only two relatively unimportant indicators of VHSC functioning and two of ASHA

functioning- both relate to payments to them and their accounting. Why has there been such a bias and what can be done to address this?

- There is one major component of the NRHM called the community monitoring programme. Is there any space to link the HMIS with this programme – from either the civil society leadership of this programme or from the government? What have been the barriers to such integration?

The current situation is that there has been little progress in all these four concerns expressed above – mainly because other priorities have preceeded it and because civil society which provides the impetus and leadership for developing the community process components of NRHM has never been seized of the need to synergise its efforts with HMIS and much less with issues of HMIS design that are critical for such synergy.

To address these concerns we suggest the following steps:

1. Feedback HMIS reports to community level institutions in a form which is immediately relevant and understandable to them. Ask them to respond to this. In particular some of the more visible indicators like child or maternal mortality could be corroborated by VHSCs in a quarterly institutionalized process.
2. Put in place a annual triangulation of HMIS reports with community monitoring reports in the course of "conversations over data" programme where community representatives participate to understand and incorporate the community voice. This exercise should lead to not only validating data, but also exploring reasons and solutions for the identified programmes as well as to identifying problems and constraints that HMIS does not capture .
3. Develop monitoring guidelines and indicators for the five community programmes- ASHA, VHSC, RKS, community monitoring programmes and NGO participation and begin a periodic monitoring of these programmes- correlating programme outputs with larger outcomes as measured in HMIS. This has been described in the earlier chapter on use of information with reference to the ASHA programme.

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Measuring Equity in Health Care

The challenge of measuring equity is the challenge of collecting, analyzing and reporting on disaggregated data. Let us explain this further.

A data element is the record of an event. Thus a child is given BCG vaccine. This is an event.

However is the child below one or above one year of age, is it male or female, is it urban or rural, is it below poverty line family or not, is it from a SC or ST or OBC community- these are all attributes of the same data element. If we were to capture all these dimensions we would need so so many separate disaggregations of this singular health event. Only if recorded in the disaggregated form can they be added up.

Thus we would have to record that a child from a SC family, below one year of age, of female gender, above the poverty line, from an urban areas was given the BCG vaccine. This is one disaggregated data element. To capture all these variable we would need 64 such disaggregated data elements. Reporting and aggregating so many disaggregations would greatly increase the burden of reporting, would seriously decrease the reliability of reporting and would make little difference to management decisions. Yet one needs data on equity.

We list below six options- from the simplest to the more difficult options:

Getting at disaggregated equity related data

- Only from survey
- Only from one or two indicators
- Sentinel Sites
- Interpret geographic inequities
- Sample study of registers
- Electronic with health records

1. Stick to collecting disaggregated data from annual health surveys and DLHS. Since this has mainly use for policy purposes, survey data has marked advantages over routine reporting based data- and there is no advantage to be gained by collecting disaggregated data on the HMIS. Surveys are still the only way to record the cost of care – an increasingly important indicator for equity in public health systems.
2. Collect one or two dis-aggregations on a very limited set of data elements in the HMIS- which will provide all the usable information needed- while keeping the reporting data low. Thus in the current HMIS we ask for male, female break ups in only for the full immunization data element. For all other individual vaccines we do not ask for the gender disaggregates. Since it is unlikely that gender would have a varying impact with different vaccines, this full immunization figure is adequate for all necessary action. The RIMS- Routine Immunisation Monitoring System asks for all gender break ups – but there is no evidence that such breakups have ever been used. Similarly we could collect SC/ST breakup only for institutional and home deliveries- and not for all the other indicators related to quality of care or other maternal care services. Our information about differential access would be the same.
3. Develop a few sentinel sites- carefully chosen by stratified sampling to be representative. Here put some additional manpower and generate the disaggregated information. Then one could apply these same proportions to the larger data base of all facilities.
4. Inequities by geographic dispersion are well available in the current HMIS. This would enable good comparisons across districts – across blocks etc. Since these blocks would correlate with socio economic

contexts, the difference between blocks could be used, after adjusting for the local health systems context, to reflect on health inequities.

5. In the recording register insist on maintaining the attributes of the child or pregnant woman in a separate page. Then if information is needed take a sample of these registers through a survey- perhaps once a year we could get the disaggregated data needed.
6. Computerise the recording register and create a data base of each name with all its attributes. Thus whenever a service is delivered all the disaggregated information becomes available- and the tracking register and the aggregate reports are generated electronically. This answer seems the simplest, but as we know from three years of struggling with it, is a huge effort with relatively low returns. However eventually once we move to electronic case records and registries linked to HMIS, this could become much easier. But this may take more time. The name based tracking system has the potential to generate this information- but in practice this has not yet happened. We could learn from this.

Review Questions

Q1. Differentiate between public health triangulation analysis and conventional epidemiologic analysis.

Q2. On key indicators of RCH service delivery, what are the data sources and possibilities of triangulation at national, state and district level?

Q3. How can HMIS provide space for the community perceptions and knowledge to be heard? How can communities contribute to improving the quality of data on HMIS?

Q4. How can communities contribute to monitoring of health programmes? Explain the role of community processes and monitoring triangulation in HMIS.

Q5. Why does one collect data disaggregated for caste/community, for economic status or for urban-rural location. If these cannot be part of routine reporting (for reasons discussed elsewhere) how then can policy makers and district level managers get this important information.

Q6. The lesson enumerated six ways of collecting disaggregated data, relevant to understanding health equity. Discuss which is the easiest of these, and which the most reliable?

7 The Architecture of Health Information Systems

In this lesson we shall learn:

a. What do we mean by HMIS architecture, why we need to focus on an architecture perspective as compared to a standalone system, and the issues and problems raised by sub optimal architecture.

b. The main choices in architecture before a designer? Lessons from the Indian context.

c. Principles of architectural design of information systems.

Why Think About Architecture?

While a village would not need architecture for planning, city development would definitely need one. Similarly a villager building his hut may draw upon common experience which is available with local artisans. In middle class sections, people would plan it by themselves with some advice from the contractor or engineers. But many others would today take the help of an architect, and if it were a multi storey complex of houses, the architects help is mandatory.

Sometimes towns grow into cities and mega-cities and their development plans are grossly inadequate. In a dynamically evolving city environment it becomes a challenge for an architect to intervene. Most people would, however, agree that without efforts to draw up "architecture" for how the city should develop, the situation would be even worse.

This is analogous to the situation in health information systems. Many information systems are already in existence- much of it is paper based and some of it electronic. There are also a large number of reports being collected. Then more get added on every year - till one has a lot of data on flow, sometimes in parallel and sometimes at cross-purposes. At some point it becomes necessary to rationalize the flows- while continuing to respect the traditions, diversity and history of different systems in operation. Such rationalization would also pave the way for a massive expansion of use of health information. One also needs to plan for such an massive expansion

of information use- but while doing so we should learn from the past and evolve some basic principles of designing such information flows.

In the development of HIS, architecture is a process tool, which at any point would be defined by the current understanding and knowledge, which would necessarily be inadequate and incomplete, and which will need to be flexible enough to enable the incorporation of new developments - which by definition cannot be pre-determined.

It is important to remind oneself, that architectures are not an end-solution – and there is nothing like a *perfect* architecture. This discussion on architecture should merely be seen as an approach to manage complexity. The point of departure, from the usual intuitive approach to architecture is to conceptualize architecture as a verb – something that is always in the making; - rather than as a noun- representing an end solution. An understanding of architecture provides a road map or compass for "good design" of health information needs in a health system.

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What is Architecture as Relevant to HMIS?

Architecture represents a system of systems. In the Indian context the following health information systems would be the minimum necessity- (as identified in the working group papers of the 12th Five Year Plan)

1. Registration of Births and Deaths – for demographic purposes and to provide base-lines
2. Service Delivery in the public health system- the main role of the current HMIS system- helping to make decentralised district and sub-district level management decisions as well as support better resource allocation from state to districts and within districts to facilities/ providers.
3. Morbidity and Mortality profile as emerges from care seeking at public and private hospitals. This helps estimate burden of disease and facilitates policy decisions at state and national levels. Placed on a GIS platform it could identify geographic concentrations- endemicity- of disease.
4. Disease surveillance to detect and act on disease outbreaks and epidemics.
5. Nutrition surveillance - Monitoring under-nutrition and wasting and acute changes in nutritional levels.(linked to ICDS programmes).
6. Programme Monitoring support for national health programmes: helps identify programme gaps or areas where there are greater challenges.
7. Support human resource management within the public health system.
8. Support financial management – from resource allocation, resource transfers, accounting and utilisation to financial services – making of payments to facilities, providers, beneficiaries.

9. Support for drugs and supplies procurement and logistics.
10. Provide hospital information service- to improve the quality of care to patients through electronic medical records, to improve hospital administration through collection and analysis of hospital performance indicators, and to provide data inputs to the district health management information system on health events and health service delivery
11. Provide a platform for continuing medical education and for consultation support to doctors from advanced centres of learning and a platform
12. Reduce the burden of work of service providers in record keeping, and easy retrieval of records relevant to their work, and support to referral of patients
13. Support regulatory functions of the state- by creating a nation-wide registration of clinical establishments, manufacturing units, drug testing laboratories, licensing of drugs, approval of clinical trials.
14. Support the organ retrieval and transplantation programme.
15. Support to emergency response systems and referral transport arrangements.
16. Improved access of public to public health information and of individuals to their own health records.
17. Improved transparency of government decisions.

There are other unproven and unstated ambitions that information systems acquire- like policing the system for fraud, or improving accountability of services- and it is not quite clear how an information system would achieve such roles.

States which are more developed in information systems – like Tamilnadu have systems in place for about 10 of the above functions, while there are other states where only two or three of the above functions are computerized. States are in very different levels of both flow of information and computerization of data. In some states there are computers in every primary health center, whereas in others data entry and analysis is still only at the district level.

Moreover there are multiple isolated systems running for some of the above functions. Thus for National Health Programmes we have separate systems for AIDS control, for vector borne disease, for tuberculosis control, for disease surveillance, for immunization, for tracking pregnancies for maternal care and children for immunization. Distinct from all the above, the main information flow which is currently equated with the term HMIS, is a system, which primarily records service delivery as related to reproductive and child care, some elements of mortality with a focus on child and maternal mortality, and some basic details of general outpatient and in-patient case

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Thus for National Health Programmes we have separate systems for AIDS control, for vector borne disease, for tuberculosis control, for disease surveillance, for immunization, for tracking pregnancies for maternal care and children for immunization

loads and laboratory services in the public health facilities. The latter system is meant to include private sector data also, but in most states only a small part of the private sector information is captured.

But architecture is not only the description of information flows on different themes. This flow is embedded in a social and political context- the institutional structures, their history and tradition and relationships with the community; as well as a health systems context- a relationship with the technical interventions and their organizations. There are multiple stakeholders- such as international donors, ministry officials, vendors, infrastructure providers, civil society, service providers who shape the flow of information and the uses it is made of it and there are choices to be made in technologies.

As a social system, Health Information Architecture is therefore much bigger and qualitatively different from a computer or the IT network, or only the HMIS which deals with aggregate statistical reporting. It is not only difficult to change; it resists changes as it involves redefining power relations. This would be far from a common-sense assumption of HMIS architecture being determined by professionals, coming up with a rational solution of the best way to do things. There is a messiness in the way it pans out, full of unintended consequences and surprises even for the most painstaking and rigorous architect.

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Guiding Principles

Systematically studying the growth and development of different information flows and systems in India and elsewhere, and learning from the NHSRC experience in both setting up the flow and in promoting use of the information, the following basic principles of information architecture can be elucidated:

1. **User-defined:** There is a need to carefully map out the different users and their uses for the information in some level of detail. Information must be for action. Focus needs to be on, essential data and indicators linked to targets and real usage.
2. **Heirarchy of information needs:** There is a need to further categorise the information support needs across the various horizontal and vertical dimensions of the HIA. Different levels and types of management in the health sector have varying needs. (Vertical= block, district, state national; horizontal= immunization, maternal health, IDSP, malaria etc as required at the district or state level).
3. **More data granularity at more decentralized levels:** Lower levels need richer and more granular data, higher levels need less data, in a more aggregated and analyzed form.
4. **Decentralised analysis and interpretation:** Users at every vertical level must have access to the data appropriate for their level and be able to specify their own information needs and generate it from the

data in the form of reports, graphs, maps, and statistics. They should not be dependent on others for reading and using their own data. At every level presentation of the information and the form in which it is available is important.

5. **Autonomy and its pre-conditions/boundaries**: Managers at every level- vertical and horizontal should have the autonomy to decide their own data needs and systems to analyze and use it, provided the following four non negotiable conditions are met:
    a. Their systems meet standards of interoperability- and can communicate electronically with other systems which also meet these standards.
    b. That the data set they collect includes the essential data elements as required by their higher/reporting authority.
    c. That the data definitions and data quality standards they use are the same across the systems and their storage and use of data in consistent with a data policy.
    d. That service providers and midlevel managers who are the data sources have to report each unique data element only once into one data screen. After which it is upto the systems to design information flows such that this data is distributed to all those users/information systems who need it.

In addition there has been an appeal made to include a clause that input/output standards required for improved access to those with visual or other disabilities be also adhered to. This is a requirement, that the systems is only recently getting sensitized to.

6. **The data warehouse approach**: This is also referred to as the data repository. There is a need for a site of integrated information; all information from different areas should be available at "one point" from where various users can access them. For this reason, the repository, is also referred to as the web-portal. Note, that the web-portal is primarily a common portal (portal: entrance or gateway) for access to data by multiple users. This would enable triangulation of information across data- bases, better use of information for planning and management and a much larger information base for each programme manager to work with. Web-portals are not to be designed as portals for entry of data – for entry may take place in their respective systems in a decentralized way. They are primarily meant to be portals of access to information.
7. **Re-designing work process along with redesigning work flows**: There is need for caution on taking requirements for information needs based on the existing work practices and information flows. It carries the danger of automating and thereby enhancing the problems created by existing inefficiencies. One must carefully study

Managers at every level- vertical and horizontal should have the autonomy to decide their own data needs and systems to analyze and use it, provided the four non negotiable conditions are met

Web-portals are not to be designed as portals for entry of data – for entry may take place in their respective systems in a decentralized way. They are primarily meant to be portals of access to information

the processes and organization of work and the role played by information flow- and re-design these work-processes if necessary, in parallel to designing information flows.

These seven principles seem non controversial when stated in an abstract manner. But let us look at the contemporary debates in the direction of expansion of the HMIS in India to understand these issues of architecture better, and why an integrated architecture is difficult to achieve.

HMIS under NRHM: the first five years

HMIS, with some element of computerization, has been in the nation since at least the late 1980s. Flow of information on paper, with manual aggregation has been around much longer. In the mid-nineties, putting in place an improved and computerized HMIS was made a central component of health sector reform under all state health systems development projects. Most of these were bilaterally funded by international aid agencies, notably the World Bank. HMIS for malaria began in 1988 and in 2002, a major renewed thrust at building a web-based information system for malaria was started up. All other vertical programmes, notably the AIDS control programme, the tuberculosis control programme and the leprosy control programme and the immunization programme also launched their programme specific management information systems within the last 15 years.

The National Center would receive data from the districts on the national web-portal which became functional in November 2008 All paper formats of submission of monthly data to the center were abolished at the same time

With NRHM financing the development of state health systems, the need arose for a national HMIS, and further for an integrated HMIS. Also it was recognized that most of the information systems in place at national and state level were not working well and a fresh effort was to be made. NRHM in the period from November 2008 to November 2010 saw the first efforts at HMIS reform and as part of this moving towards articulation of an HMIS architecture. The initial design – expressed in the Mission's GO dated November 2008, specified the following:

a. The National Center would receive data from the districts on the national web-portal which became functional in November 2008 All paper formats of submission of monthly data to the center were abolished at the same time. Data was to be entered every month. The data entered was district aggregated data and it was on a centrally standardized format. This format included all RCH data and some elements of blindness control programme and the national leprosy control programme. National Center used this portal for its own analysis. There was no commitment to feedback. A few basic reports analyzing the state and district data are made available. But users could not use the portal to by themselves to access or analyse the data – even at their own level. Analysis done was primarily macro in nature to detect trends, inconsistencies and outliers in data.

b. States and districts were allowed to have their own local systems for district level data analysis and use. Tamilnadu, Rajasthan and

Maharashtra had built up their own systems under state health systems projects. In 19 other states NHSRC partnered with HISP to provide DHIS2 as an open source solution for states who want it. States/ Districts could customize their own forms and add in data requirements and whatever further features they needed - as long as they submit to one output… which is the nationally standardized format. This output was uploaded onto the national web-portal. The web-portal did not develop the ability to allow facility level data till 2010, and even then only partially, and it did not have any functionalities for meaningful analysis of data uploaded at any level. This was the space in which DHIS2 and other parallel state level systems were permitted.

c. The definitions of data elements and indicators were standardized, and the format and frequencies of reporting was also standardized.

d. There were some feeble efforts at integration- but after some time, the malaria control system, the IDSP and the RNTCP systems were allowed to continue in parallel. The Immunisation system was initially asked to close down- but soon it also started up again. So integration could not be achieved.

In all these systems it was the same service providers who were entering data and the data had to be entered in different formats and fed into different systems, I These systems had no inter-operability and it was not possible to make them "talk to each other". It may be noted, that being rigidly vertical programmes, there was little communication and drive for integration even without the IT design constraints. The supervisory structure of each vertical programme, preferred to talk to its most peripheral worker of service provider alongs its vertical chain of command. The situation was worse with malnutrition data, AIDS control data and registration of births & deaths, as these belonged to different departments. No effort was even made to integrate with these data flows.

Despite the failures in integration, the achievements were remarkable. For the first time on approximately 270 data elements, information was received every month from every district. Analysis of quarterly and annual data was done district wise and made available for districts and states to access.

However data quality was perceived as poor and the capacity to use information at all levels was limited- for both reasons of software design and of human skills. Dissatisfied with the quality of data available, a perception arose amongst administrators, that with greater granularity of data flowing to the center, where facility level and even individual level data would be received at the national repository- the ability to improve data quality would be enhanced. An alternate view was that data quality depended on many constraints related to organization of information flow- and neither false reporting nor lack of granularity was a limiting factor. In this alternate view what was needed was an increased capacity to use information and to identify and solve data quality issues.

All public health IT system have no inter-operability and it was not possible to make them "talk to each other"

Alternate view was that data quality depended on many constraints related to organization of information flow- and neither false reporting nor lack of granularity was a limiting factor

HMIS Architecture in Flux

As soon as the web-portal could permit facility level data entry, which was about November 2010, the closing years of the XIth five year plan, the debate on architecture, settled in November 2008, opened up again. The centralized option sought every facility in the country - from sub-center to district hospital, to directly enter their data into the central web-portal and the shutting down of every other state level system, especially DHIS2. Many states shifted to this approach. However a few states worked on and still remain committed to what is implicitly an alternative decentralized approach. We elaborate on these two directions of HMIS development as two alternative architectures and discuss the pros and cons of each choice.

To design a national architecture, all the systems should be interoperable with each other

One direction of change- (which we refer to as option 1) was an enhanced national web-portal hosted on one mega-central server. All facilities from all across India, including sub centres, would enter data directly into this central web-portal. The web-portal would generate the aggregated district and block reports. Users would log in to find reports of their district and blocks. Potentially facility/ block users can go to site and analyze their data- but in practice, this was still not possible. Only a limited range of analysis reports were available in the public domain through the portal. Graphical analysis was limited, and spatial visualization was not possible.

One problem that emerged was issue of ownership of data. When the facility entered the data directly the district would have to confirm the data. If district felt a data entry was wrong, it could correct or edit the data before confirming it. The same process was repeated at the state level. But often districts and states would not own the data directly entered.

Many states which were having their own software for analysis and use of data now faced a problem. The facility level data entered in their applications could not be uploaded into the national web-portal for it did not meet any criteria of inter-operability. Since connectivity at the facility level was poor, paper versions of the data sheets had to be brought to block or district level and every one of the 270 data elements had to be entered one after another for over 400 facilities. Making these district or block level data entry operators, enter this huge volume of information twice once into web-portal and once into the state level system/DHIS 2 was not acceptable. Faced with this problem the pressure from the national center was to enter only into the web-portal and drop the other state level system. Whether or not the district could analyse and use its data was not the center's priority. Serious thought was also not given on why at national level, data of all sub centres was required, when the principle would be for them to receive only aggregated and indicator based information. Under this pressure for direct facility based entry, the number of states using a parallel system dropped from 25 to about 14.

The main justifications for the change to facility based reporting and name based reporting were to improve data quality. The perception was that it

was difficult to check poor quality data because one received aggregate numbers. If we had the numbers disaggregated by facility, then we could track the false reports easier and it would make for more "truthful" reporting. In this logic, the best way to detect and prevent false reporting would be to have further disaggregation - down to individual names of pregnant woman and children. That was what was started up first but it soon became clear, that the technical and human resource demands on this was far more and would need to be done by a parallel system. So taking central control over the HMIS data required that at least the facility based reporting be speeded up. It was also felt that having facility level data would enable better planning at central level- though it was not quite clear how it would be done. Loosely it related to the fact that RCH and NRHM had a lot of emphasis on developing 24*7 PHCs and FRUs and the state of monitoring of these was poor. Facility level reporting was expected to enable better monitoring of this key objective. However as of date, these objectives of improved data quality have not been met by the act of facility based reporting.

Facility based reporting does not necessarily imply mandatory entry directly into the web-portal or closing down of earlier systems. But since there was no standards of inter-operability in place, in effect that was what happened There was another reason for insisting on direct entry. It was felt that if there was only one source of 'authentic' information, there would be less confusion and duplication of work. One complaint against multiple systems had been that if corrections were made in the web-portal, then these corrections would not be reflected in the parent or primary system- and a second version of the truth would thus survive. However there was no insistence on maintaining a documentation trail that could be used for audit- no record of what are corrections were made, when they were made or who authorized it. This led to a situation where data on the web-portal would be continuing to change long after its initial entry and without any publicly visible explanation. Also it was now possible for a mid- level manager to correct not only the data

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in the aggregate form, but also go downwards and change the facility level data entry also- which could not have been done with multiple systems.

The other major problem was that all states started going in for further information systems- eg. For hospital management, or human resource management, for drugs and supplies logistics, for birth and death registration etc. But none of these new information flows could be accommodated in the national web-portal. They could not even communicate with it- and every one of these systems would have to be stand-alone information flows. However the data on one system could often make meaning only when combined with the data on another- and this was not possible.

An alternative approach - building a decentralized system centered on district use of data

Given these problems one must return to the earlier approach of separation of the national web-portal from state level systems and see how to develop this. Such an alternative approach was indicated in the working group paper on NRHM that was submitted to the 12th five year plan and in the background note to the steering committee of the 12th five year plan. The main features of such an alternative could broadly be summarized as follows: We discuss this approach as option 2.

In decentralized system national web-portal is seen as a gateway of access to information, but not a portal of entry

1. In this option the national web-portal is seen as a gateway of access to information, but not a portal of entry. Entry can take place in any system, but the data must be electronically transferred to the national portal. The national web-portal must be able to communicate with and get the data it needs from all other health information systems. Using this data the national web-portal casts about 15 national indicators- and provide access to information from all other systems.
2. Districts would upload district level aggregated data, plus quarterly calculated performance scores - on 70 indicators. The choice of denominators for the indicators would be based on standardized estimates that districts made and which are reviewed from the center to ensure data fidelity. These performance scores or rates could be displayed also as a GIS nationally and at state level and such a GIS display would help locates areas of poor performance rapidly. This would also encourage states and districts to analyze, interpret and own their data.
3. States would have parallel applications on own state server. These applications must be externally reviewed and certified by a body for functionality, for user-friendliness, for security, for inter-operability and for conformity to nationally established data standards. In the first three parameters, each application would state what functionality and user friendliness and security features it provides- the external body merely documenting and certifying this to be so. The STQC of the department of IT has a very robust process

of such certification of software and this should be insisted upon, with the state government paying the costs of such testing and certification.

4. Facility level data is entered on these state applications. Whatever facility data is required by national and state levels are sent up on request, electronically ready and downloadable by the center from a website. The state applications/software must be designed such that every site where data entry is done is also a site where analysis of the data for performance rates and trends and management decisions are possible. This means at the least a high degree of data analysis capacity and appropriate pictorial display of data must be available at the level of the the facility, block and district level.
5. The role of the national office would be a) standardize data and indicator definitions, b) specify data quality standards, c) specify inter-operability standards, d) build up the technical authority and capacity to oversee and regulate conformance with these standards and to ensure that there are electronic channels for communication in the vertical- state, national level and in the horizontal - with HR management applications, drug logistics applications etc.

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The justification for such an approach would be:

a. That it would enable very effective decentralization. Based on the facility level information district managers can move resources to facilities which need them more and provide more support to facilities doing poorly.
b. The design is essentially a district health information system and its ability to satisfy national data needs is a by-product or collateral gain. Organizations are more likely to improve the quality of data, if they are regularly using it.
c. The level of technology introduction would match the objective and subjective readiness of the district to absorb this technology. More modules, allowing more functions can be progressively added on – at a pace convenient to local management and feasible in term of technology development and support for maintenance.

The STQC of the department of IT has a very robust process of such certification of software and this should be insisted upon, with the state government paying the costs of such testing and certification

Let us then compare these two approaches against the architecture principles we established in the earlier section:

In Option 1- the centralized option, the data needs of all users are defined at the national level. Of course the national level has done this through a careful consultative process- but obviously some stakeholders would command more space in the final decision making. More important there are important local needs for information- that would need to be added in at the district level. For example there are specific programmes for endemic diseases like kala-azar, fluorosis, sickle cell anemia, high altitude sickness etc which are not universal problems and to add these data elements into

the decentralized, approach, the data needs of local users can be factored in- even upto block and district levels since the systems allow it and anyway one can have multiple systems at different vertical and horizontal levels

the national web-portal or a centralized format, just adds to the burden of every facility reports. Also due to uneven development, some regions and districts have more programmes - like programmes for non communicable disease. If all data fields are defined centrally and must appear on the data entry screen of a national web-portal, then most of the local variations get excluded. In Option 2, the decentralized, approach, the data needs of local users can be factored in- even upto block and district levels since the systems allow it and anyway one can have multiple systems at different vertical and horizontal levels.

there is more data than can be used at national and state levels and because of lack of tools of analysis, less information than is needed at local levels

The second option could be built around the principle of a hierarchy in information needs and allows for greater granularity of data at lower levels: In option 1, the same data elements are available at all levels. Though block and facility level data would be available at national levels, it would be difficult to make interpret them as denominators and contexts are not known. Thus there is more data than can be used at national and state levels and because of lack of tools of analysis, less information than is needed at local levels. In option 2- the hierarchy is part of the design: the national level can see all the state level data and most of the district level data. Below that it would only seen indicators- not raw numbers unless it specifically asks for it. Similarly the state can see most of the district and some of the block information. The district can seen the block data and some of the facility data- and the block can potentially see all facility data and some individual or family specific data. In option 1, the analysis is done centrally- and very little information is available- and very late and that too after passing multiple gate-keepers to the data. A block would not be able to see its own data trends or performance, till the gate-keeper allows it, and then too they would see only that analysis as the national level has the time and inclination to put up. In option 2, users at every l level would have access to the data appropriate for their level and be able to specify their

own information needs and generate analysis offline or online from the data in the form of reports, graphs, maps, and statistics. As long as it is their own data or the data from a facility or area under them in the reporting hierarchy, they would not be dependent on higher -ups for reading and using it.

As of today, data definitions and formats are standardized and the essential data elements and indicators needed at the national level to be collected are specified. However the central systems cannot communicate with each other or with state systems. The excel sheet upload function is a very weak and inefficient way of establishing communication. There are no standards of inter-operability specified and no effort made to ask for it. Secondly, ANMs have to enter the same data element twice of three times. Thus a vaccine given to a child would figure in the RIMS software, the HMIS software and in the child immunization tracking software- thrice reported by the same ANM on three different formats., thrice data entered, thrice aggregated and when triangulated at the district or state level never matching each other. This is a huge increase of burden of work for no advantage. Once a standards based approach is put in place, with a central mechanism for monitoring adherence to the standards, most of these problems can be overcome.

In the current design of HMIS- option1- the national webportal is the data warehouse, but it is only the warehouse or repository of information of one of the flows relating to the HMIS. And secondly it cannot be drawn upon by any user of the same horizontal or of different vertical levels. A data warehouse, on the data input side, must receive and manages data of different types from varying sources; and on the output side, process and present the data and provide a multiplicity of users with data, tailored for their specific needs. Such a function does not currently exist. However even with a better implementation of the national webportal - such a singular data warehouse would also be part of a centralized architecture. In option 2 - the decentralized architecture the need would be for each horizontal level to have an integrated warehouse and each system to have its own independent warehouse in addition to the centralized ones. Thus we would have at least district and state warehouses or web-portals– in addition to the national ones.

A Social Systems Perspective on HMIS Architecture

We said in the introductory paragraph on "architecture", that design has close relationships to contexts in terms of health systems, organisational culture and relationships of power between stakeholders. So far we have only examined the logical or rational reasons for choice of design. We now look at the perceptions and power of different stakeholders, so as to help reflect on the choices between designs.

One perspective that drives the centralized version of health information architecture is to see HMIS as a tool of accountability and monitoring

One perspective that drives the centralized version of health information architecture is to see HMIS as a tool of accountability and monitoring. The central government gives financial resources to states and states to districts. The central government has to ensure that states use it well to improve the functioning of facilities and the quantity and quality of health services. States have a similar relationship with districts. The system is meant to collect this data pertaining to this and send it up.

Implicitly the act of reporting data is also the act of holding themselves accountable. The requirement of reporting relationships and flow of data mirrors and reinforces the chain of command. In this logic, the data elements appearing on the format become a reminder of functions- nudging the service provider to carry out the service and holding him or her accountable.

central "eye" of the top administrator must notionally "see" all that happens below. And everyone below is aligned to that "all seeing gaze" and has a relationship to it

The central "eye" of the top administrator must notionally "see" all that happens below. And everyone below is aligned to that "all seeing gaze" and has a relationship to it. In sociological literature, this has been called as the "panopticon". The act of reporting and being reported to in itself gives meaning to the entire system. The actual use of information is a less important by-product. It may happen, or it may not. The more that is seen - i.e. made visible to this eye- the more the accountability. Thus if facility level reports become 'visible' as compared to only district reports being visible- so much the better. Since few have been actually reading and acting on district level reports so far, there is even less likelihood of reading, interpreting and acting on facility level reports. Collectors and mission directors talk of being able to 'drill down' and 'see' every facility. Now there is much excitement about the power in their hands to drill down and know the names and mobile numbers of each pregnant woman and child. In one innovation at improving HMIS, video camera was introduced into every sub-center to make the visibility even more literal. This was hailed as a major achievement. In Punjab, daily SMS based reporting from mobile phones of ANMs was ordered to strengthen monitoring of her on a daily basis - though the huge quantity of data generated thus was never analysed and acted upon.

This brings us to some more curious features. Sociological literature not only notes the existence of such 'panopticons' in various institutions, but notes that after such elaborate efforts are made in setting them up, more often than not, the central watchtower from which the eye 'sees' is never manned properly.

This fits is very well with what we know of the use of data – there are many, many data elements that have not even been looked at even once since it started flowing. It would also explain better why there is so much effort to not tell the truth, and to hide the problems and report only what the mid level manager perceives as the things that top level management wants to hear.

Is this theorizing of features called for? A theory is useful – if it explains more phenomena, predicts new developments better and does so better than a rival theory. And we do need to find better explanations for why after decades of efforts; an effective HMIS is still so difficult, and why the same "mistakes" continue to repeat.

Another important dimension in the Indian context is the cadre of statisticians and demographers that form the core of M&E work, and who are entrusted with the task of HMIS. There is much literature on the perceptions and professional privileges of medical professionals and how it shapes the development of health systems. There is on the other hand almost no literature on how making 'M&E' works an almost exclusive preserve of this statistical cadre within government, influences and shapes the development of HMIS. As statisticians in charge of M&E, they perceive themselves and are perceived by others as in a privileged position- giving meaning to numbers. Within a largely positivist framework, it empowers them with the power to pronounce on programme success and failure. As statisticians, they take the numbers given to them and look for trends and outliers and the levels of confidence which they can attribute to numbers. Every data entry operator and public health person being able to make their own interpretations based on locally derived indicators could also modify the role that statisticians have had especially at the district and state levels.

There is much literature on the perceptions and professional privileges of medical professionals and how it shapes the development of health systems. On the other hand there is no literature on how to make M & E works

This privilege of the statistician in HMIS is contested - or at least modified - by the emergence of a new professional- the IT professional. Many statisticians especially in the population resources centers did not even make the transition to IT based statistical packages. From data entry operator and data manager, rising to become HMIS managers and as software vendor and designer, the IT professional is now emerging as a major influence in shaping health information systems. Every problem of HMIS appears to have an IT solution and the problems that persist are to be addressed through even more application of IT. Central contracts and large systems spanning across states have their in-built attractions for large proprietary IT vendors and for those who would do business with them, and these large players would have much more funds to invest in marketing and salesmanship.

The other major stakeholder in HMIS is the international funding and technical support agencies- USAID, UNICEF, DFID, WHO, UNFPA, NORAD, ECTA and now the Gates foundation. Every major institution dedicated to HMIS and every major survey on which we base our health information except those under the Registrar General of India and the NSSO are financed and provided technical assistance by these agencies. No doubt,

these partnerships are only at terms which the Government of India decides on- but it is useful to compare the surveys like DLHS across nations and the issues with such HMIS and disease surveillance systems across nations to understand the patterns and priorities. But more about this later.

What about the data itself? Even if we agree with the theory that HMIS performs an accountability function fairly independent of the data, how does this accountability driven architecture affect the final product- the quality of data available and how it is used for action. We can make the following three observations:

1. Data quality is compromised if the information is not used. If data is not used at district and sub-district levels, then its use at all levels is compromised- for it is at these levels that data quality issues have to be identified and corrected.
2. Poor quality of data would justify poor use of data- and this non use of data leads to further poor quality of data- and without local use of data this vicious cycle cannot be broken. All data used for policy purposes- for reporting to Parliament, for reporting to Planning Commission, for sanctioning of PIPs etc are from surveys like DLHS and there is now an investment being made into annual health surveys. However, there are nations, like South Africa, where surveys have been given up, for the routine HMIS gives adequate quality and much better disaggregation of data.
3. The contribution of false reporting by service providers is only one of the factors and perhaps the least important factor in the poor quality of data. The causes of poor data quality have been discussed in detail in the first chapter of this book. It is not that falsification of data (as distinct from false reporting) does not occur- but the evidence points to this occurring at intermediate levels - rather than at the periphery. If we admit this possibility of falsification at intermediate levels, even as a hypothesis and then consider its implications for the architecture, we come to some surprising conclusions. If every facility data can be changed at will by an officer at the district or state level who has the access, and if there is no shadow or trail of the original data retained and no record of who made the corrections when, because all data was entered directly into the web-portal and nothing was retained for local analysis and use, then it actually becomes a system that aids data manipulation. A given target of achievement could be decided upon at the state level and each district is disaggregated and could be told the numbers it must provide to reach this target, and then this could be further disaggregated and even facility level figures filled backwards- so that each facility's quota for each activity is achieved. Indeed it follows that the design requirement for encouraging truth telling on HMIS is that we actually encourage multiple systems that can communicate to each other- but where from higher levels, one cannot tamper/alter with the information of lower levels.

Why would a midlevel manager or for that matter a top manager want to tamper with data one way or other? The answer requires an understanding of the multiple roles of a public health system in the current socio economic structure of society and is beyond the scope of this book. Suffice it to state, that architectures evolve to facilitate or to limit falsification of data, and its final design is a matter of choices made, not accident.

An HMIS Architecture for the 12th Plan

There was considerable importance given to the development of health informatics in the inputs provided for the making of the 12th five year plan. This included sections on health informatics needs in all the seven working groups set up for the plan. In addition the high level expert group on Universal Health Coverage set up by the Planning Commission, and the working group on NRHM and on tertiary care had detailed sections on health informatics where they considered issues of architecture.

Summing these discussions up the background note on health informatics placed before the steering committee on health presented the following proposal as regards the architecture:

a. The role of the centre would primarily be defining, in a participatory and scientific way, the data definitions, data standards, data quality requirements and standards of interoperability, which all publicly financed application of information technology in the health sector, must necessarily sub-scribe. A data policy would also be put in place that would define how long the health data must be stored and in what electronic form and with what back-ups and what provisions for the right to access, security of information and privacy. The centre would also have to develop procurement policies which permit open source technologies to be considered and which allow arrangements that could support software that is constantly evolving- as different from one, which is a one-time product.

b. The department of health would encourage and support the development and deployment of systems for each of the above use in a decentralised way, but with enforcing the standards mentioned earlier so that there can be data sharing across systems- and so that the service providers do not have to enter the same data element more than once. Thus if malnutrition data of a block is available on one system and the deaths and incidence of acute respiratory infection are available on another system, each of these systems should be able to acquire the information of the other system in a seamlessly and electronically. "The approach would be towards permitting multiple systems which meet the well defined and regulated standards with each user level or institution able to access information most useful at that level- rather than one single system to which all data entry and interpretation in the nation must conform. If such architecture is

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created, the 12th five year plan period would see a massive expansion in the integrated use of health informatics..." Working group on NRHM of 12th fFive year plan. Development of such state level and programme specific systems would be financed under the NRHM or respective programmes. But financing would be conditional on the systems being consistent with these national standards and the national health-care IT architecture. There would be technical support made available for helping states to articulate the system requirements, develop appropriate tender document and procurement procedures and subsequently to test and certify the software for functionalities, usability and security as well as for compliance with the national data standards and standards of interoperability. States that do not have the capacity to build their own systems in any of the areas listed above can choose from a suite of open source applications available with the central government, and adapt and deploy it for their use. The emphasis on all such software development is on the use of the information- not on information gathering as an end in itself. States must have their own applications hosted on their own servers and they can add as many more data elements and reporting formats as they need. They can also add on modules for HR management, hospital management, disease surveillance, m-health, GIS, private sector regulation, urban health, nutrition management etc- depending on the states priorities and readiness.

The centre would specify its minimum information requirements- for policy, for resource allocation and for management purposes- and the states would ensure that their systems are designed to deliver this electronically to the web-portals at desired levels of frequency and quality

c. The centre would specify its minimum information requirements- for policy, for resource allocation and for management purposes- and the states would ensure that their systems are designed to deliver this electronically to the web-portals at desired levels of frequency and quality. State and district health systems are designed primarily for local action, but as a collateral benefit, they would be able to generate the information needs as required by the centre and send it in the format required.

d. A computer with internet connectivity should be ensured in every PHC and higher facility- in this plan period and also extend to sub-centers in those states which are ready for that transition. (All sub-center which have mobile access would also have the ability to connect to internet and can be computerised- but because a much higher level of skill development would be required and there are other skill development priorities in the sub-center- this is not being made mandatory for sub-centers).

e. The center would have three national data warehouses/web-portals- one for aggregate numerical information as generated from health management information systems and surveys, another for its regulatory and stewardship functions and a third as a public interface on health information and for health promotion. These could be integrated into one web-portal- but to prevent information overload

and maintain user friendliness, it is perhaps best kept as three portals with inter-connectivity. These web-portals would be able to communicate with and complement state systems and acquire their information needs from them. The states, and even districts, could have their own data warehouses and these data cannot be altered except at that level and that too by a transparent process which is laid down.

f. Electronic medical records are encouraged as a tool of improving quality of care, and enabling better referrals due to the portability of the record, more access to patients about the care they received and also as a data base for health research. Some of the states which are ready to make the transition to electronic medical records(EMRs) and they would be encouraged to do so. Some states would be in a position to introduce hospital information systems which support administrative and public health action while introducing EMRs only for in-patients or for certain category of patients who by definition need sustained and highly portable follow up records- and not try to get all patient interactions on EMR. Still others would only be able to generate the public health data requirements- which is the minimum permissible- and this too should be understood. The real danger is in trying to transit to EMRs when the professional community, especially in public hospitals is not yet subjectively prepared for such a transition and when there are still a number of policy and technical questions to be resolved. The major part of public investment in information technology in health care would go to institutional capacity building for understanding and use of information. Incurring large expenditures on hardware and software without making a matching input in capacity development and institutionalisation would be an error. As part of this, every state should have the skilled human resources needed at state and district level. This would require a mix of those with IT skills and public health informatics skills. State centres for health information, either stand alone, or embedded in existing institutions would be essential and district teams of three to five persons for managing information flows and interpreting information would also be essential. The facility, the block and the district would have the capacity to analyse and use information. This means the skills, the requisite software applications and the hardware, and the enabling orders and organizational processes to do so.

g. The use of ICT in a) health education and health communication and b) in the generation of health knowledge would be expanded. These two functions would be located in two appropriate national centers- one dealing with public health and health promotion and the other with health research.

Electronic medical records are encouraged as a tool of improving quality of care, and enabling better referrals due to the portability of the record, more access to patients about the care they received and also as a data base for health research

The major part of public investment in information technology in health care would go to institutional capacity building for understanding and use of information. Incurring large expenditures on hardware and software without making a matching input in capacity development and institutionalisation would be an error

h. All district hospitals would be linked by telemedicine channels to leading tertiary care centers and all intra-district hospitals would be linked to the district hospital and optionally to higher centers. The availability of "skype" and similar applications for audio visual interactions makes telemedicine a near universal possibility and could be used to ameliorate the professional isolation that professionals posted in rural and remote areas face.

i. M-Health- the use of mobile phones to speed up transmission of data and reduce burden of work in reporting, to improve connectivity between providers, and as a vehicle of health communication would be built up.

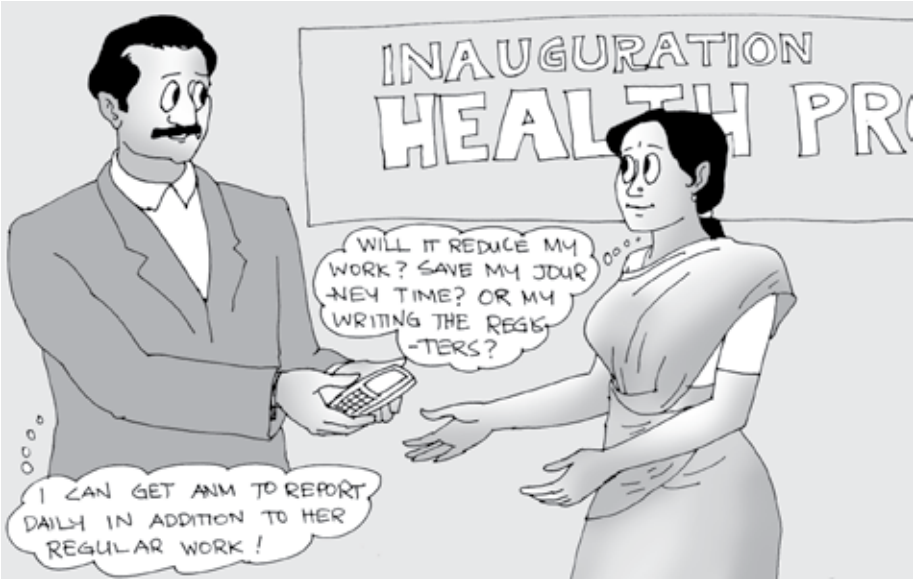
j. With respect to governance, the advantages to transparency of government processes are many and obvious and these should be fully enforced. Not only is it a matter of complying with the right to information, but even district health plans and procurement processes should be visible. The role of IT in ensuring accountability of peripheral staff and even more its role in prevention of fraud for eg in checking on payments to beneficiaries- needs to be ascertained by careful evaluation- before it is generalised. At any rate policing should at best be a minor, collateral function of ICT in the health sector.

k. All ICTs in health, whether in state or the centre should be professionally evaluated for performance against stated objectives and this should be used to improve on the HMIS architecture. ICT projects should begin with approved functional and technical design documents which would provide one reference point for evaluation. The other consideration is the value addition that the application of ICT provided to reaching health and social goals.

All ICTs in health, whether in state or the centre should be professionally evaluated for performance against stated objectives and this should be used to improve on the HMIS architecture

The central motivation of the HMIS must be that districts and blocks are enabled and empowered to make their own decisions. Decisions would largely be in terms of allocation of resources- human, financial, technical AND in terms of strengthening monitoring and providing support or designing new programmes or activities. For doing the above, districts would need information- as quickly as possible and as user-friendly as possible- for the average district and block manager is busy and has neither the time nor capacity to deal with complex statistical tools. As a by-product of the above process- the limited information that higher levels need can be sent up to state and national level- without any parallel data collection, aggregation or data entry. The applications must be built such as to ensure this reporting function is automated.

The role of the center is not unlike the modern urban planner- who puts in place the building standards and the plans for connectivity between buildings- roads, sewage lines, water, electricity, and the standards that buildings need to have to access to these, and develops a blueprint that demarcates the zones. But for the rest allows each housing society and each family to plan their own buildings to suit their own needs.

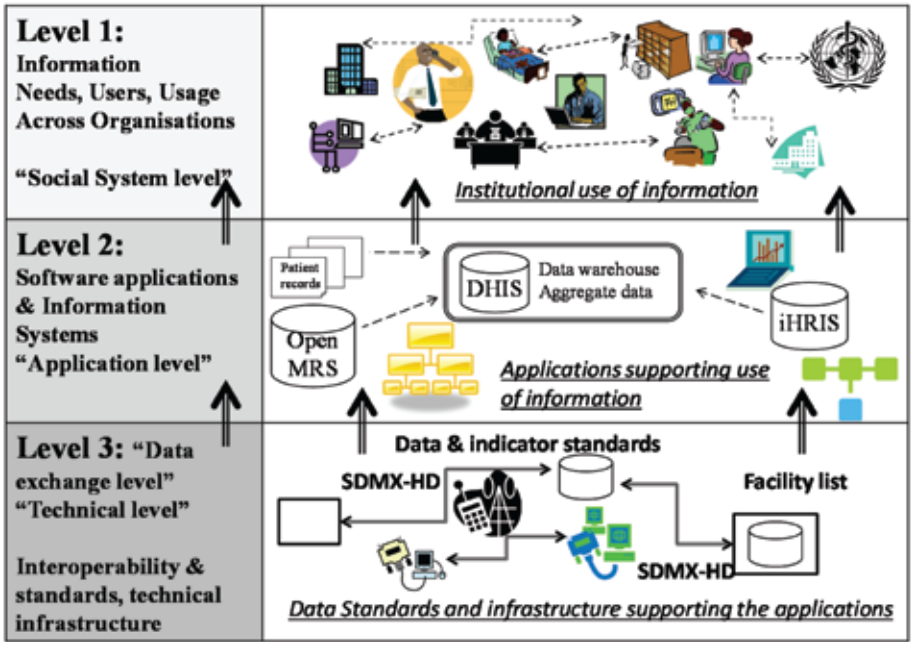


The alternative is for the architect to try and build every house down to the last detail- or even require everyone to live in the same hostel. Even if it could be done,… is it desirable?

The IT Basis of a HMIS Architecture

Having looked at architecture from the view point of information flows, of social structures and perceptions, we could also look at it in terms of information technology requirements. There are many ways of expressing the comprehensive national architecture requirements of health information systems. One is to define it in terms of three layers of enterprise architecture:

Enterprise architecture: 3 Layers



Enterprise architecture: 3 layers

The first level could also be called the health systems level and it where the public health leadership needs to be proactive in defining. The second level is the IT part of it and it is determined by what both what the first level and what the third level specify. (the picture about shows a district warehouse linked to a HR management module and hospital module and electronic medical records as would be relevant in following individual patients needs, as is done in pregnant women or young children). The third level is the standards that, data, indicators and applications have to meet. Types of standards are described differently; from formal standards for data exchange to data dictionaries of data standards and semantics.

Review Questions

Q1. What do we understand by health information architecture, as different from a health management information system or an IT network.

Q2. Why is integration of different flows of information important? What are the different flows of health related information in a district/ state?

Q3. Enumerate a few generic guiding principles of health information system architecture.

Q4. What are the challenges to integration of different information flows/ How does interoperability contribute to integration?

Q5. Compare the two approaches to health information architecture – a centralized system which provides for all functions and allows only one version of truth and decentralized, plural approaches with standards of inter-operability. Discuss the advantages and disadvantages of each?

Q6. How are health information systems perceived as contributing to better health systems? How is health information architecture influenced by such differences in perceptions of the objectives of the health information system?

Q7. The public health manager, the IT expert, the statistician and demographer are some of the technical contributors and stakeholders involved in the design of HMIS. What are the strengths and limitations of each of these professional backgrounds in designing HMIS architecture.

Q8. The design of HMIS systems is dynamic- forever evolving and changing. What design features would be essential to cope with this constant iteration and change?

8 Approach to Evaluation of HMIS

In this lesson we shall:

a. Understand the objectives of HMIS evaluation.
b. Understand the approaches to HMIS evaluation.
c. Understand what to evaluate applications for.
d. Using evaluation to improve HMIS design.

Introduction

One of the many surprising aspects of HMIS is how little it has ever been subject to evaluation. This is surprising for two reasons. Firstly monitoring and evaluation are usually part of the same job description- and therefore the persons in charge of the HMIS are often those who are also in charge of evaluation. Despite this, when it comes to their own work, the trend is to use common sense instead of professional evaluation. HMIS is expected to build the evidence for action. But where is the systematic evidence or even the effort to find the evidence that it acts to improve health outcomes? Secondly huge sums of money are spent on building HMIS systems. Most programmes that entail such expenditure would call for evaluation. But in the HMIS area, failures are usually quickly forgotten and the new systems building starts again from scratch. There is little to no learning from past failures. There is even a failure to admit past failures- a denial of its history, and an effort to present the development of HMIS, as if it all began just now – starting from scratch with a clean slate. Even in empowered committees and international funding agencies, the case for HMIS is often made as if the concept has just been discovered.

One reason for the lack of evaluation is because often administrators believe that they "know" the cause of failure- they assume it is because of insincerity and falsehood in reporting, especially from the peripheral levels. Or they assume they got an incompetent software firm- and the next software company is around telling them how they are going to solve it all.

One reason for the lack of evaluation is because often administrators believe that they "know" the cause of failure

Evaluation has technical institutional & organisational discussion. Too often evaluator see only the technical dimension and leave the other dimension out the of equation

But perhaps there is no area of health systems development which needs evaluation inputs as urgently as HMIS does.

What do We Evaluate HMIS for?

HMIS systems need to be evaluated for knowing whether it serves the larger purpose of improving programme outcomes and health impacts. Such evaluation help improves its design and functioning.

The contribution of HMIS to the overall health impact could be measured by four questions on HMIS output:

- Is the information that the system capturing the most *relevant*?
- Is the information made available *reliable* in terms of quality (completeness, consistency, accuracy) and timeliness?
- Is the information user-friendly enough to support action- (ease of access, ease of interpretation for the programme manager)?
- Is there the *capacity to act* on the information provided?

In answering each of the above questions there is a technical dimension, there is an institutional and an organisational dimension including relating to human relationships and the power (as) symetries. Too often the administrator and even the evaluator see only the technical dimension and leave the other dimensions out of the equation. What do we mean by this?

Let us take a simple example- the reporting of child deaths. The technical dimension is simply the definition of a child death (till what age) and the various aspects of the death we want to know (place? cause ?) and the way the information is aggregated (district level or block level? Or by cause etc.) and presented (IMR? Under 5 MR? etc.) and what is the data source? The organisational dimension would be who is responsible for reporting and to whom is the reporting done. How the person responsible for reporting finds out and what problems they face, which compromises the quality of the information. It would also include the implications of reporting the death- on the person themselves and on their superiors. It also would include a description of the action that the report triggers and to some extent the adequacy of that action.

One could argue that whether there is capacity to act on information, is not the responsibility of HMIS. The counter-argument would be that it is not useful to collect and provide information, beyond the capacity to act on it. Of course information is needed for research and some policy needs which would not be immediately actionable- but these could be collected from surveys or sample studies. There is no need to engage the entire workforce in the act of collecting and analysing data unless there is management use of it.

But another more positive way of looking at this is to see HMIS as central to capacity building and human capacity as one of the intended outcomes of

HMIS. Amartya Sen in his book "Development as freedom," places emphasis on human agency, rather than on institutional and structural conditions as the criterion of development. Development is about enhancing the capabilities of individuals to make the choices they value. In such a view, development is about removing the five "unfreedoms" to achieving the potential of our individual capabilities- Social; Political; Economic; Security and Transparency.

In such a perspective, the key questions that evaluation asks would be:

1. Does the system contribute to reducing the disparities and inequalities between individual and groups?
2. Does the system foster capacity building and information systems skills amongst user groups, especially those marginalized and those in the periphery?
3. Does the system increase the possibilities of enabling local customizations and content, which is responsive to local needs and supports local traditions (e.g. language) and which allows greater participation of communities?
4. Does the system facilitate interaction and collaboration between different levels: user-community; medical doctors-nurses; district administrators-medical fraternity; international aid agencies-ministry officials etc?

Obviously an evaluator cannot pose these questions, if the policy did not have these objectives at all. But the immediate context of HMIS evaluation is the National Rural Health Mission and the reforms in governance that it is aiming for. Broadly, NRHM seeks to make architectural corrections in the public health sector based on a "health systems framework" as contrasted with a disease or programme specific approach. In such a context, the criteria to evaluate HIS reforms within the framework of the NRHM reforms could be stated as:

1. Have systems been decentralized? And have the decentralization of the HIS contributed to a broader decentralization of decision making processes?
2. Have systems been better integrated (intra health and intra sector)? Have the integration of the HIS contributed to broader process of integration of the various programmes under NRHM?
3. Has the implementation of the HIS contributed to more effective evidence based decision making? And has this contributed to more effective health outcomes?

These are currently no evaluation studies that have been constructed with such a background understanding- and as the XIth Five Year Plan period comes to a close, and there are strident calls for strengthening/initiating HMIS in the XII Five Year Plan- nothing could be more urgent.

Development is about removing the five "unfreedoms" to achieving the potential of our individual capabilities- Social; Political; Economic; Security and Transparency

The Users and Uses of Evaluation

Evaluation reports are valuable to programme managers to know the strengths and limitations of the information system, so that they can take more informed decisions with it- and also contribute to improving it.

Evaluation reports are valuable for HMIS managers for improving the efficiency of the system and data fidelity.

Evaluation reports of HMIS are valuable for policy and strategy decision makers, so that they could improve the design of the system and invest wisely rather than heavily in HMIS- and so that they know how best to complement information from HMIS with other sources of information for policy decisions.

Evaluation reports of HMIS are valuable for policy and strategy decision makers, so that they could improve the design of the system and invest wisely rather than heavily in HMIS

Evaluation reports of HMIS are also important to take an objective view of achievements before the decision is taken to scale up projects state-wide or nation-wide. Too often the enthusiastic portrayal of the system by its vendor, or the professional pride of the designer or the feeling of empowerment and excitement of the administrator whose "ability to see" got greatly extended through the innovation, becomes a substitute for hard evidence on whether the enhanced flow of information led to enhanced programme implementation and outcomes.

Software Evaluation (Testing and Certification). Within the range of HMIS evaluation there is also a need to flag one important component of the evaluation- namely the testing of the software to ensure that its functionality, user friendliness,security features and its adherence to standards of inter-operability are all independently and objectively verified. Most software vendors never provide a large number of the features that they promise. In case of open source software or where source codes are promised as part of the contract, there is a further need to verify that the entire source codes are submitted and they are indeed usable and possible to programme on further - by an independent software testing agency.

Designing Health and hospital information systems are not the most difficult of IT applications or solutions to design and deploy. If surprisingly they have proven so resistant to solutions in the Indian context- one of the central reasons for this is no doubt the almost complete lack of any professional evaluations of such systems. But that brings us to the problems of methodology.

Evaluation Methodologies for HMIS Evaluation

Broadly we could approach HMIS evaluation from two stand-points:

1. A Cost and performance analysis (similar to cost-benefit analysis).
2. A development impact analysis.

In the first approach we study:

a. The costs of establishing and running the HMIS- including all elements of the cost including some hidden costs- and correctly attributing hardware costs- since the hardware may be used for many other purposes. Costs should also include human efforts in collecting, entering and communicating information and the costs of training the personnel involved in this effort.

b. The reliability- completeness, timeliness and accuracy- of the information provided.

c. The usability of the information provided.

d. The actual use that is made of the information provided.

While studying each of the above we would need a causal analysis of the causes of problems or constraints in any one of the above dimensions. These causes could be technical, it could relate to adequacy of hardware, software or human resources, it could relate to the organisation of information collection, flow and processing, or to institutional mechanisms of allocation of roles and accountability for different functions. The first chapter on data quality indicates the approach to understanding these dimensions, and should therefore be incorporated as one of the important components of evaluation of HMIS.

What we get from such an evaluation is a cost benefit analysis- and a performance audit. It also helps us understand how to tweak various features of the system so as to make it more efficient and effective. Given enough time, money and effort one could get to any level of information that one desires- but the point of the evaluation is whether for the benefits realised - the time and effort and money spent on it, was worth it? There is an opportunity cost to the time. If for example on the introduction of a new system of information gathering, a nurse now has to spend an extra few hours on recording and reporting data, the question is whether these extra hours would otherwise have been spent on nursing patients.

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In the second approach we study all the above, but the focus is on the impact that information makes on programmes – not only health outcomes and improved service delivery- but much more so on the management processes and the reform processes- community roles, decentralisation, better resource allocation, integration etc. Taken together we could call this the developmental impact.

For studying developmental impact and for improving on developmental impact the key issue is the understanding of programme theory and the relationship between contexts, mechanisms and outcomes. In contexts we have to consider primarily the health systems context and within this the institutional framework and organisational culture, and to a lesser level, the socio economic and epidemiological context. Mechanisms are

For improving on developmental impact the key issue is the understanding of programme theory and the relationship between contexts, mechanisms and outcomes

the software, and the organisation of work and information flow and the capacity building efforts. Outcomes would be improved clinical outcomes, improved management outcomes but outcomes could also be degree of decentralisation, responsiveness of the health system, empowerment and satisfaction of providers and health care users etc.

The term "Programme theory" refers to a framework of understanding of a stakeholder group on how mechanisms of HMIS would interact in this specific contexts to provide outcomes. Even which outcomes are expected could be different. Since there are many stakeholders and many relationships there could be considerable variation on programme theories and expectations of different stakeholders. The evaluator of HMIS looks for a developmental impact made by the system and for this must start with making these usually *implicit* programme theories, much more *explicit*.

Let us paraphrase an example from Ray Pawson and Nick Tilley's "Realistic Evaluation".

A CCTV is installed in a car park to prevent car thefts. The evaluator has to assess whether it is effective?

Now there are many possible programme theories for how a CCTV works to prevent care thefts. These could be listed as follows:

- **Caught in the act:** present offenders are caught and removed from the system. (which means hide the camera carefully)
- **You've been framed:** potential offenders are scared off because they know they'll be caught. (which means advertise the use of CCTV as loudly as possible)
- **Behaviour change:** People start using car parks more, and leads to increased 'natural' surveillance as anyway thefts from within car parks are less
- **Effective deployment of scarce human resource:** may help deploy human resource more where thefts are more likely to happen or come in from.
- **Publicity mechanism:** visible statement of govt acting- will deter potential car thefts- so that citizens are re-assured that government care
- **Memory jogging mechanism:** reminds drivers to lock their cars: encourages responsible behaviours
- **Appeal to the cautious:** those who anyway lock their cars start using the parks and the rest who are more vulnerable, don't and become more vulnerable- in which case it works in reverse.

Of course the context is important in deciding which mechanism works. If the car parks are already overflowing with cars- then getting more people to use the car park cannot be the mechanism by which it works. If there are

The evaluator of HMIS looks for a developmental impact made by the system and for this must start with making these usually implicit programme theories

severe human resource constraints- one may use it to save on staff rather than re-deploy existing staff. If it is hardened criminals we are talking about- we will not frighten them away - at best we would push them into stealing other things and so on.

Also the outputs would be different. In the first theory- more arrests and convictions is what we expect as the outcome, and in the second theory- less arrests and theft attempts is what we expect. We could have more responsible owner behaviour as the outcome.

We may also have unintended outcomes- like different time and place of thefts or just different thefts or as we see in the case of the last programme theory- even increased thefts.

The way HMIS works to improve programme outcomes is similar.

To give an example there is a HMIS programme that is ongoing which monitors every pregnant woman and every infant. What is the possible programme theory? It could be that:

- **Reducing exclusion**: Pregnancy tracking helps identifying all the pregnant women who did not get any service
- **Improving follow up**: Pregnancy tracking helps by reminding service providers to provide timely follow up and complete delivery of all service components to the pregnant woman who have registered
- **Facility supervision**: Pregnancy tracking helps by supporting the supervisor to monitor whether the service provider is providing complete services to pregnant women
- **Increase Institutional delivery**: Pregnancy tracking will lead to improved institutional delivery
- **Reducing false reporting**: Pregnancy tracking is name based and not aggregated numbers and this would help in reducing false reporting - this would improve quality of HMIS and this in turn would help provide better services
- **Reducing cheating on payments**: By reducing cheating in payments under JSY.

Obviously it is not enough to evaluate whether records of pregnant women were uploaded which were put to some use. We have to show that it led to one or more of the above changes. For example if we believe in that it helps ANMs follow up better, the evaluator has to see how often ANM got feedbacks and what value it added to the information she already had with her and whether it led to more focussed action. This could be easily done by comparing with a place where such computerised feedback is not available. Further one would have to show the additional value of receiving such automated reminders was worth the time that reporting took her off from other child and pregnant woman care activities that she is

The evaluator has to see how often ANM got feedbacks and what value it added to the information she already had with her and whether it led to more focussed action

providing. If instead one measures merely how many pregnancy records were uploaded, at best it would be an interim programme monitoring and have little to do with evaluation. This is not to say that automated reminders cannot be made useful. They can be made useful. But the task of the evaluator is to ask not whether it *can* be useful, but whether, in practice, it *was* useful.

Most HMIS managers – both from the statistician fraternity and the IT fraternity- could get satisfied with just the fact of uploading data or data on flow or even the generation of numbers and reports of all sorts - and have very little understanding of what it finally was used for. They could even assume it was someone else's task to think about this. But in fact it is not. It is very much fundamental to the design of the system. The design of the HMIS is far more than the computerisation of some aspects of information flow. One has to not only think about the way whether it improved programme management, one has to document what impact it had on decision making at local levels or in equity of resource allocation etc. The point is that if it were known that HMIS would be judged by some clearly articulated developmental impacts- then the design of HMIS would alter significantly.

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It therefore becomes important to plan the parameters of evaluation in terms of both cost- performance analysis and developmental impact at the time of the design of HMIS.

As discussed in an earlier chapter on the use of information we suggest that the following be taken as the minimum outputs *at the district level* that the current HMIS in use should be evaluated for:

a. An accurate information of mortality and facility based disease epidemiology that is used to prioritise health care interventions.

b. A good estimation of access to health care services- and clear identification of who is getting left out where.

c. An understanding of the volume, and range of services provided by each health care facility- so as to enable flow of more resources and support to such facilities as also to identify and support facilities performing below expectation for each service it is expected to deliver.

d. An understanding of the quality of services being provided in each facility being monitored which is used to guide resource allocation, and prioritise supportive supervision and skill development programmes.

e. All of the above empowers and improves the capacity of the district and block leadership for more effective district planning and implementation, for better prioritisation of programmes and resource allocation and support.

f. Provide feedbacks to the community and an interface with the community- so that they are able to contribute to information flows and

able to use information to improve their contribution to programme management.

At the state and national level the importance is in:

a. Understanding the performance of districts and directing technical and financial assistance to districts where it is needed more. To support districts that lags behind and corrects uneven development.

b. Identifying those strategic objectives where most states/districts are unable to reach and therefore rethink policy or strategy or level of resource support.

c. Support district level capacity development for effective decentralisation.

One can extend this framework of evaluation to individual indicators or even levels of reporting. For example if facility level reports are being sent to national center and every state has had to invest in changing over to such reporting, the evaluator would have to estimate the number of times and purposes for which this information was used.

In both approaches to evaluation- the cost-performance analysis and in the developmental impact analysis- software evaluation plays a distinct and independent contribution. For decisions on improving software and even for ensuring value for money spent on this software, such software evaluation- used synonymously to better known as software testing and certification has an important role, independent of HMIS evaluation.

In both approaches to evaluation- the cost-performance analysis and in the developmental impact analysis- software evaluation plays a distinct and independent contribution

Software Evaluation

Any software must be evaluated with respect to the following criterion:

- Performance of the software
- Usability of the software
- Security of the software
- Functionality of the software.

Performance: When one evaluates for performance of software one must understand the behavior of the application under a specific expected load. Will the application perform sufficiently if the current load goes well above the expected maximum? What are the upper limits of capacity within the application landscape? Determine also if the application can sustain the continuous expected load. One has to spike the number of concurrent users to determine whether performance will suffer, will the application fail, or will it be able to handle dramatic changes in load. Thus we have an application where 600 districts are uploading data. If all 200,000 facilities start uploading data and at any time about 10,000 persons are uploading data and another 10,000 persons are trying to download the data, is the application and supporting infrastructure able to manage it? If the number

of data elements is increased by a factor of 5, will it be still possible to manage? This is one type of question.

Usability is defined by ISO as the "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."

Usability has many dimensions. Is it learnable? How easy is it for users to accomplish basic tasks the first time they encounter the design? Is it efficient? Once users have learned the design, how quickly can they perform tasks? Is it memorable? When users return to the design after a period of not using it, how easily can they reestablish proficiency? Is it error-prone: How many errors do users make, how severe are these errors, and how easily can they recover from the errors? And finally how is the user-satisfaction. How pleasant is it to use the design?

Software security is defined as the process of ensuring that software is designed to operate at a level of security that is consistent with the potential harm that could result from the loss, inaccuracy, alteration, unavailability, or misuse of the data and resources that it uses, controls, and protects. This also includes the dimensions of confidentiality, integrity, and authenticity. Confidentiality is a security measure which protects against the disclosure of information to parties other than the intended recipient that is by no means the only way of ensuring the security. Integrity is a measure that is intended to allow the receiver to determine that the information which it is providing is correct. Authentication or authorization is the process of determining that a requester is allowed to receive a service or perform an operation. Access control is an example of authorization. By authorizing specific persons to upload and edit data using specified processes- data gets its authenticity. Another dimension of security is assured availability- that is the process of assuring that information and communications services will be ready for use when expected. Information must be kept available to authorized persons when they need it. A more difficult dimension of security is non-repudiation: a measure intended to prevent the later denial that an action happened, or a communication that took place etc. In communication terms this often involves the interchange of authentication information combined with some form of provable timestamp. It is a kind of software evidence of - what time has a particular transaction has been completed. For example if one user downloads data and uses it for presenting a report to the legislature – and then someone else edits the data. Unless there is a way of establishing that the data was edited subsequently, the first user could be accused of making a false statement. Thus there is much more to the understanding of security than merely safety from hackers and loss of data.

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The functionality of software is measured strictly with respect to the requirements requested or gathered. It primarily means whether it delivers the information required of it in the form it is required. It also requires

consistency of data and timeliness. Testing of functionality is usually executed with the help of test plans and test strategies measuring all the major/minor functionalities and comparing it with the Software Requirement Document signed by the end user as well as the organization.

Functionality also relates to adherence to standards of inter-operability- or communicability with other systems. This should include inter-sectoral links and accessibility to communities.

Evaluation of software is a challenging task- and there are organizations like STQC, which is supported by the Department of IT, Government of India which are exclusively devoted to this task and they do an excellent job of such testing. Most software developers find such testing useful to develop and improve their products and supporting documentation. When using open source solutions, the costs of testing and certification may be as high or higher than the costs of development of the software, and it may be useful to keep these out of the contract and have the user pay for the tests- provided it gets certified. But it is well worth the expense. It would be tragic if after three years, one fine day, the entire data crashed and got lost- and all that anyone could do was say- Oops, sorry.

This sort of crash is not so uncommon and is the reason why new tenders are floated for enhancing old solutions or building new ones with ever looking back at what we were doing previously. Currently there are a large number of such national and state applications running for a wide number of programmes and functions- and while everyone is blaming service providers for poor reporting, few have got their applications formally tested and certified.

Evaluation as Feedback, Evaluation as Design

We noted in the earlier chapter on architecture that much of the problems of HMIS would also relate to the work processes that get measured and automated. If there are technical problems with the organization or measurement of these work processes, then automation would increase the problem, rather than solve it. Good evaluation therefore studies HMIS process in relation to the organization of work process. These feedbacks into HMIS design. But they would also provide a feedback on programme design. The first act of the designer is usually to map the work processes, and the existing systems of measurement, information flow and use and then predict what automation of this would do. In the process the adequacy of current organization of work processes itself comes under scrutiny. Since most software consultancies would not look have the skills to look at the organization of work processes in the health sector - one needs inter-disciplinary teams without conflicts of interests to both evaluate past efforts

Good evaluation studies HMIS process in relation to the organization of work process

at HMIS and to do formative studies for new efforts. And it would need to be led by public health personnel who have grasped the logic of organizing information systems.

The task of the HMIS evaluator is not easy. Evaluation would necessarily have to look at costs, at performance in terms of timeliness, relevance, reliability and usability of data, organizational of work processes related to information analysis and the impact of information is quite challenging.

Review Questions

9 Getting the Software Right

In this lesson we shall learn:

a. How to define the software requirements- in terms of needs, features and software specifications.
b. Process and challenges of working out the software requirements.
c. Issues and approaches to finding an agency to develop the software.

Section-1: Introduction

One of the important tasks of a HMIS designer is to be able to spell out the requirements for the software that is needed and find an agency that is able to develop and deploy it.

From the viewpoint of the software developers also, the most important and difficult step remains figuring out the requirements. Conducting and documenting software requirements has historically been an important domain for systems development and computer science.

The other problem with software requirements is that in a public health system, the needs are constantly changing- They change with changes in the health programme and even with changes in administrators and their perceptions of the priority. On the other hand there is often considerable resistance to change, especially when a number of the users are not familiar with information technologies. Also in large government departments, the persons assigned to interact with the software firm, may have a perception of the requirements- which does not quite match the requirements of persons who would finally use the software.

Many such reasons the experience of software development in HMIS in India has been very disappointing. There are many state governments which have tried a new solution every few years and spent crores repeatedly, and still not managed a working solution. There are similar problems with the software

Collecting, rationalising, documenting and translating health program requirements in to software application are known as requirement analysis

support to the different monitoring systems of the national programmes at the center. This chapter tries to understand the issues and offers solutions to getting the software right.

Section-2: Introducing Requirements Analysis for Software

A. Why we need a requirements document(s)

A large percentage of software projects fail to be completed, or have over-runs in costs and time estimates due to lack of clarity in this requirement analysis stage.

Software requirements of HMIS need to be written out in a clear document for the agency developing the software to be able to create a project plan, to assign resources, to design system components and/or create components. If it isn't clear what one is supposed to build, how can the software agency or the department requiring the software, estimate the cost of building it? Of course, requirements evolve as a project proceeds, but carefully worded basic requirements provide a starting point. Then, as the project progresses, the developers can fill in details and update planning documents as the requirements evolve.

Requirements analysis provides useful inputs towards:

- Cost estimating – Module identification
- Project scheduling – Time lines against benchmarks
- Software design – Defining coding needs
- Software testing – For efficiency and efficacy against desired features
- Documentation and training manuals.

Common reasons contributing to poor requirements include lack of user input, incompletely documented requirements, and also a rigid system of gathering requirements being used which does not cater to changing or evolving requirements.

There are clearly two stages in this. One is the requirements statement as made before a agency is hired. This is used for getting a proposal from multiple agencies and for awarding a contract to the selected software development agency. This could take the form of a tender document. This mainly highlights the objectives that the software should fulfill and some of the conditions and contexts within which it would have to operate.

The other is the functionality and technical design documents made by the agency to which the contract has been awarded. This document sets out what the specific features that the software would have, including the number and nature of input screens and the outputs it would provide. The technical design document would indicate in software terms how it would achieve this. In any software development venture these three documents- must be the basis- the initial requirements or proposal document, the functional systems document and the technical design

document. A large percentage of software projects fail to be completed, or have over-runs in costs and time estimates due to lack of clarity in this stages.

Insist on a clear record of these documents.

B. Challenges of requirement analysis

1. One of the main challenges of assessing requirements is that one often assumes that requirements are fixed. In other words, once requirements are "frozen" for development, they do not change. This is a faulty assumption, as by nature, requirements change. Especially, in the context of a health system when there are constantly new diseases, new drugs, reorganization of health units and changing priorities of the health administrators. Change is the only constant in the system.
2. The other challenges is that development of software does not flow from requirement in a linear process- requirements, then specification, then design, implementation, verification etc. It tends to iterate back and forth- as the process of implementation and verification itself throws up more needs and issues.
3. It is difficult to get all users to agree on what the requirements are different stakeholders have very different perceptions of system requirement. Many users are not able to identify informational needs as distinct from programme management needs nor able to articulate which information would add most value to programme management.
4. It is not clear to users or developers as to which informational need gets value addition from software and which informational needs are difficult to fulfill for other organizational or technical reasons. In the latter situation, introducing software would make no difference- even worsen the problem. This places undue expectations on the software or software becomes an end in itself, rather than one of the means to address the larger end - of addressing informational requirements of improved programme management. Only a careful dialogue between developers and users could bring out problems in current information flow and judge whether or not software would help.

C. Process of carrying out requirements analysis

The process of understanding requirements can be considered as the most influential aspect of software development, as the costs of redressing the problems of "wrong" requirements can be prohibitive. This process could be seen as the process of generating three documents- the proposal document, the functional design document and the technical design document. These are not standardized terms- many agencies use different terms to indicate the same content.

Many times it is not clear to users or developers as to which informational need gets value addition from software and which informational needs are difficult to fulfill for other organizational or technical reasons. In the latter situation, introducing software would make no difference- even worsen the problem

The first document, written by programme management for bringing in a software development agency could be called the proposal document. The key element in getting this right is for the document to focus on **what** *the software has to do, not* **how**.

The second document, written by the IT solutions agency – the functional design document- elaborates on what is the deliverables in considerable detail and also indicated how the software needs to be designed to serve its purpose.

The third document- the technical design documents- is the IT architecture of the software- exclusively on how it would work.

What are requirements?

Requirements serve as the foundation of systems or system components, and can be understood as a condition or capability, which is:

a. Needed by a stakeholder to solve a problem or achieve an objective.

b. That must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed documents.

Stating requirements

"The system should be able to inform the district health management on what health services were provided in a facility and to how many people- by gender and specified age categories and inform the district management of the quality of care as defined by a set of indicators specified for that purpose. This would be useful for management to decide on resource allocation to the facilities as also to monitor and ensure that the minimum volume, range and quality of services as assured for that facility are being achieved."

The two statements. The second statement of requirement- indicates whose requirement, what information and for what purpose. The first statement specifies how to gather information- but does not say, for whom, what or why!!! The first statement is an example of how NOT to write a requirement statement.

Section-3: Preparation of the Proposal Document

This document is putting down on paper what value addition the software would bring about in the existing process of information flows and programme management and why (to address what programme needs) such a software solution is being sought.

Preparation of proposal document has the following steps:

1. List the current process of information flow, it could be currently on paper, or there could be an existing system. List the different data elements collected, the indicators they are used for.
2. Describe what uses are being made of different data elements and indicators as currently available and what management actions or policy actions such information supports. If it is not being used, define why it is so. If some of the desired information is not becoming available or reliable- describe why it is so.
3. List possible new information requirements and their uses.
4. Define how the informational availability would make a difference to programme management leading to better programme outcomes.
5. Define what are the problems that the introduction of software is going to solve- especially as related to informational needs.
6. Define the objectives of the proposal for bringing in the new software. This should be a clear statement of what is the informational need and what the software has to do. How it will do it, is not to be defined at this stage.
7. Specify what needs to change in the nature of work organization so that with IT in place the system as a whole could act better. It is seldom that lack of IT alone is the gap.

8. Define the context of application and utilization. This is both the IT environment and the health systems environment. The IT environment includes, the hardware that would be available, the level and quality of internet connectivity, the other IT systems and applications that need to be linked with and the IT skills available or envisaged. The health systems context includes the nature of users and their operational space, the current needs and the likelihood of changes.
9. Finally one would have to define the standards – both in data and in systems that the software must meet. For example whether it should be open source or not, what standards of inter-operability it should comply with etc. Also specify the tests/process of verification it must undergo.
10. One would then also describe the time line for development and delivery of the software and the post installation maintenance and support period and terms.

Taken together – we have the proposal document in place. This document is best prepared by programme management itself. If needed it could hire a consultancy to assist. It is best not done by an IT solutions firm- unless it is clearly debarred from applying for the next and more remunerative software development stage. A consultancy may even recommend not to go in for a software. In a sense this is a feasibility report – and if found feasible also preparing the proposal document. It would be a good idea to make this document public and invite comments- so that we get the best definition of the problem.

To reiterate, this stage just specifies what is needed of the software- not how the software would provide it. It prepares a document that can be used to hire a IT solutions agency

Section-4: Preparation of the "Function Design" and "Technical Design" Documents

This is done by the IT solutions firm/professionals hired to develop the software. The software development team would have both skills at defining the "software requirements" in greater details and articulating it as features of the software- or specific functions the software would be able to perform. The needs of the end users would have to be understood with respect to their everyday work and the information support that is required for it, rather than on what the software can do. The software needs to be adapted to the user rather than the other way around.

Some of the fundamental prerequisites of defining requirements at this stage are that each requirement must be:

1. Documented.
2. Actionable - i.e. the developers should be able to understand from it, the specific system functions that need to be developed and how can these be tested.
3. Measureable - we should be able to tell how many features need to created in relation to a requirements document.
4. Spell out the different criteria by which the various features can be tested, and what are the conditions for success.

The creation of such a function design document can provide the following benefits to the overall system:

1. Develops a clear understanding of the needs (both current and planned) of users, other administrators/stakeholders.
2. Develops a collaborative relationship between users, administrators/ stakeholders and the technical team.
3. Serves as a concrete medium or "boundary object" for communication between the different stakeholders, especially the users and developers. This could be used by programme management to hold the software developers accountable- it could also be used by the software developers to protect themselves from unfair expectations and demands of the management.
4. Helps to create a sense of commitment and ownership of the different stakeholders in the system.
5. Helps to instruct the developers on the deliverable and its verification.

The "functions design" document: description

This has three sections:

1. Information Needs of different stakeholders.
2. Software Features.
3. Software Requirements Specification.

The information contained in one section should be referenced in the others.

The first section captures information needs, the second translates these needs into one or more features, and third details these out as specifications. Using these three separate documents helps to simplify the process of requirement reviews. Maintaining separation among these different sections allows specific readers to understand specific parts of the system. It also promotes better accountability – a key element for a successful software development process. The three documents are described in some more detail.

Requirements Specification document

Requirements Specification document. Using these three separate documents helps to simplify the process of requirement reviews. Maintaining separation among these different documents allows specific readers to understand specific parts of the system. It also promotes better accountability - a key element for a successful software development process. The three documents are described in some more detail should always be developed in an iterative fashion, and requirements need to be assessed with each iterative cycle, and changes made in one document should be also reflected in others to maintain consistency. Stakeholder needs, which are part of the problem domain, describe what stakeholders require for a successful project. In other words, needs describe what the application should do to improve processing of health information, to strengthen programme management and/ or to meet other obligations

Many often, users and stakeholders don't know how to solve the entire problem but would be able to explain what information they need to do their job better

While capturing information need is a step toward formulating a solid requirement, it cannot stand alone; it must be first translated it into one or more features that you capture in a Software Features document. Those features, in turn, must then be detailed in the Software.

1. Documenting stakeholder needs

Documenting stakeholder needs involves identifying, understanding, and representing different viewpoints. Often, users and stakeholders don't know how to solve the entire problem but would be able to explain what information they need to do their job better. Each stakeholder sees the problem from a different perspective. Therefore, it is important to understand the needs of *all* stakeholders in order to visualize the entire problem domain.

The first step therefore is to identify all stakeholders. Users represent a class of stakeholders, but by no means do they represent the interests of the whole system. In our case, other classes of stakeholders may come from administration, finance, donors, ministry officials as well as from other departments or organizations that directly or indirectly support or benefit from the project. The first step is to identify all stakeholders.

In a Hospital information setup the stakeholders would include: Data Entry operators/ Registration and Billing Clerks, Lab Technicians, Pharmacists, Doctors, Nurses, Administrative Staff (Store Manager or personnel required for Stores, accounts etc.) and Hospital Administrators (Medical Superintendent).

We then need to identify at least one representative from each stakeholder class who can speak reasonably for the entire class. Various techniques have been developed within software engineering to gather stakeholder needs including one-on-one meetings, questionnaires, storyboarding, and Joint Application Development (JAD) sessions.

The needs assessment process can be conceived to have the following steps:

a. Understanding from the users what the needs and expectations are using various techniques.

b. Studying existing work practices, information flows and documents and tools in use.

c. Analyzing the above to understand areas where there is lack of clarity, ambiguous or contradictory needs and resolving the gaps and contradictions.

d. Preparing the Information Needs section of the Functional Design document, and presentations of the same. These would include cases and mock up screens and sample output reports using the information already available. These could be shared with stakeholders and developers to ensure a shared understanding of the needs is developed.

2. Documenting software features

Information needs, once identified, need to be translated into a set of distinct system features. Needs do not indicate a particular solution; they simply describe what the programme needs. Features include details of the software that can translate the needs into a solution. "A feature is a service that the system provides to fulfill one or more stakeholder needs."

It is important for the development team to understand the distinction between needs and features and to record them in separate sections/ documents. While needs are part of the *problem domain*, features are part of the *solution domain*. It is critically important to fully understand the problem domain before deciding on a solution; often, you will find opportunities to generalize the solution once you fully understand the problem. In other words, by separating needs from features, you can find a common set of features that will meet multiple needs.

3. Documenting software requirements (as distinct from programme requirements)

Analysis of needs and features leads to the development of software requirements which can be seen as "a software capability that must be met or possessed by a system or a system component to satisfy a contract, standard, or a desired feature." Software requirement must satisfy criteria of contract obligations, standards, or desired needs and features.

Software Requirements can be functional or non-functional:

Functional requirements present a *complete* description of how the system will function from the user's perspective. They should allow both business stakeholders and technical people to walk through the system and see every aspect of how it should work – before it is built.

Non-functional requirements, in contrast, dictate properties and impose constraints on the project or system. They specify *attributes* of the system, rather than what the system will do. For example, a non-functional requirement might state: "The response time of the home page must not exceed five seconds."

Some characteristics of a Software Requirements Specification document include:

1. **Lack of ambiguity:** The software development team will be unable to produce a product that satisfies users' needs if one or more requirements can be interpreted in multiple ways.
2. **Completeness:** In the beginning of your project, you should not expect to know all the system requirements in detail; the development team should not waste time trying to specify things that are bound to evolve. As the project proceeds, however, you should keep your Software Requirements Specification document up to date; as you gain more knowledge about the system, the specification document should grow more complete.
3. **Consistency:** You cannot build a system that satisfies all requirements if two requirements conflict or if the requirements do not reflect changes that were made to the system during the iterative development and functionality testing.
4. **Traceability:** The team should track the source of each requirement, whether it evolved from a more abstract requirement, or a specific meeting with a target user.
5. **No technical design information:** As long as requirements address external behaviors, as viewed by users or by other interfacing systems, then they are still requirements, regardless of their level of detail. However, if a requirement attempts to specify particular subcomponents or their algorithms, it is no longer a requirement; it has become technical design information.

Use cases define a step-by-step sequence of actions between the user and the system

4. Capturing functions requirements

Functions requirements include three categories of information:

1. Use cases (pictoral representations. flow charts and mock up screens)
2. Functional capabilities
3. Business rules.

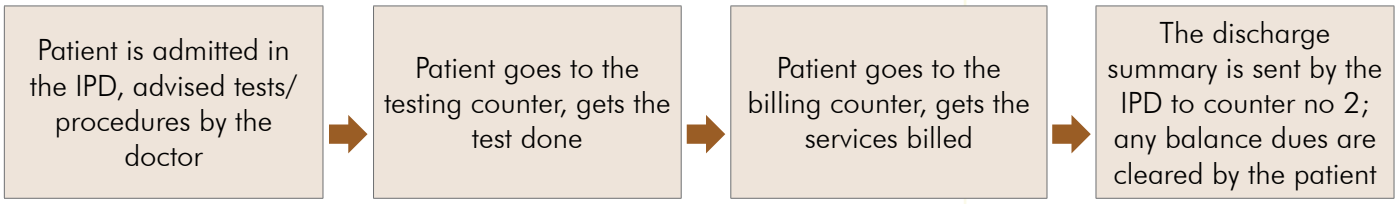
Use cases define a step-by-step sequence of actions between the user and the system. Use cases have quickly become a widespread practice for capturing functional requirements for software. They represent sscenarios that describe how the product will be used in specific situations. This can be in the form of written narrative that describe the role of an actor (user or device) as it interacts with the system.

Use cases help to engage for users who can easily follow and validate the use cases, and the accessibility encourages users to be actively involved in defining the requirements. A scenario is an instance of a use case, and represents a single path through the use case. One may construct a scenario for the main flow through the use case, and other scenarios for each possible variation of flow through the use case (e.g., triggered by options, error conditions, security breaches, etc.). Scenarios may be depicted using sequence diagrams.

Use cases provide the following benefits:

- Are easier to create, read, and understand than traditional functional specifications
- Show how the system will work from the users' perspective rather than the system's perspective
- Force us to think about the end-game: What is the user trying to accomplish by using the system?
- Require us to define how the system should work, step-by-step
- Provide an excellent basis for building test cases and helping to ensure that these are built before the code is written
- Provide a common requirements "language" that's easy for stakeholders, users, analysts, architects, programmers, and testers to understand.

Use case example



It is important to capture use cases using a standard template that contains all the components of a complete specification. These include a use case diagram, primary and assisting actors, triggering events, use case descriptions, preconditions, post conditions, alternative flows, error and exception conditions, risks and issues, functional capabilities, and business rules. Use cases become complete requirements with the incorporation of functional capabilities and business rules that apply to the use case.

Functional capabilities define what specific action the system should take in a given situation. These can be described directly to a specific case or globally for the entire system. For example a functional capability could be to provide a feedback report with information analysis to each facility every month. Or another example could be issuing an alert to a reporting facility if data entered is beyond some boundaries set for it etc.

Business rules state the condition under which a use case is applicable and the rule to be applied. For instance, a business rule related to a use case

might state, Only the Registration administrator may modify the demographic details of the patient once registered. Like functional capabilities, business rules can be directly related to a use case or defined globally for the entire system.

Example of use case: A part of development of hospital information system

INVENTORY

UC-16 – Generating requisition of indent

The *sub-store manager* should be able raise indent for the inventory/ drug stock for a drug which is depleting.

Preconditions	Success Guarantee
■ User must be logged in to the systems with *sub-store manager* user role. ■ The inventory/drug must exist in the system. (as starting point approved drug list 51 exists in the system + 500 inventory items) ■ The inventory/drug for which indent is being raised should not be more than maximum level. ■ The inventory/drug should be depleting for indent raising to be allowed.	Indent is raised for the inventory / drug by the *sub-store manager*.

Main success scenario

1. *Sub-store manager* should be able to look at the current inventory/drug levels for an item in this sub-store inventory
2. *Sub-store manager* should be able to select an item from inventory/drug and generate indent slip with:
   - 2.1. Name of the item
   - 2.2. Quantity required
   - 2.3. Date of last indent
3. *Sub-store manager* should be able to save the indent slip
4. *Sub-store manager* should be able to take print out the indent slip
5. *Sub-store manager* should be able to take print out indent slip, put signature and send it to the M.S for the approval
6. System should be able to reflect the indent raised by the pharmacy at the main store
7. *Sub-store manager* should NOT be able to edit the indent slip which has been saved in the system, but should be able to void/cancel an indent prior to approval by the MS and be able to re-create new one
8. Indent slip should then go to Main store after approval.

Extensions

1. Each department in the hospital should be listed as sub-store in the system
2. Each department sub-store should have user login
3. Each department should be able to have respective inventory and be able to maintain it
4. Each department should have inventory list and be able to generate indent.

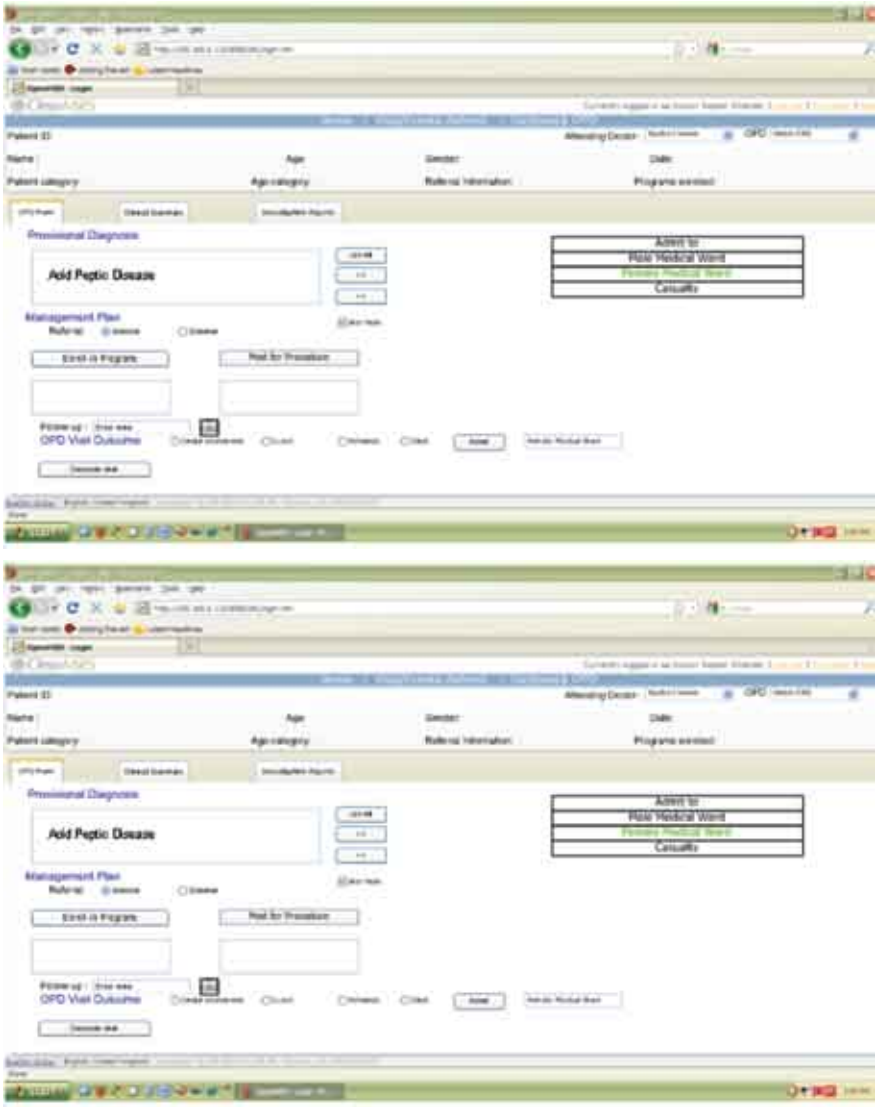
Source: HISP INDIA project on Hospital Information System Development

Mock ups

Mock ups is another technique of communicating the developers' understanding of the requirements to the users. Mock ups can be a full-size model of a design or device, or a smaller scale representation of the final system, for example of a user interface. It can be used for teaching, demonstration, design evaluation, promotion, and other purposes. In

software development, the aim of the mock up is to create user interfaces that show the end user/developer what the software will/should look like without having to build the software or the underlying functionality. This enables a proper visualization, and catches problems before the effort is made in developing the whole system.

Mock up: Examples from HISP India's project on hospital information system development



5. Capturing non-functional requirements

Non-functional requirements are attributes that either the system or the environment must have. Such requirements are not always in the front of stakeholders' minds, and often the designer must make a special effort to draw them out. These can be organized in five categories:

1. Usability (or user-friendliness)
2. Reliability

3. Performance
4. Supportability
5. Security.

Usability describes the ease with which the system can be learned or used. A typical usability requirement might state:

- The system should allow novice users to install and operate it with little or no training
- The patient should be registered within 30 seconds with the requisite demographic details
- The patient dashboard should get updated as soon as the lab technician enters result for a particular patient.

Reliability describes the degree to which the system must work for users. Specifications for reliability typically refer to availability, mean time between failures, mean time to repair, accuracy, and maximum acceptable bugs. For example:

- The system shall meet the terms of a Service Level Agreement
- The mean time between failures shall be at least four months.

Performance specifications typically refer to response time, transaction throughput, and capacity. For example:

- All Web pages must download within three seconds during an average load, and five seconds during a peak load
- While executing a search, the system must be able to display 500 search results per page.

Supportability refers to the software's ability to be easily modified or maintained to accommodate typical usage or change scenarios. Here are examples of supportability requirements:

- The system shall allow users to create new indicators or modify them without the need for additional programming
- The system shall allow the system administrator to define different rules and authorizations for different category of users.

Security refers to the ability to prevent and/or forbid access to the system by unauthorized parties. Some examples of security requirements are:

- User authentication shall be via the corporate Single Sign on system.
- Only authorized administrators shall be permitted to access patient information.

An illustrative example of functional design document: hospital information system

Needs documentation

a. Currently, while district hospitals contribute a significant proportion of the primary and secondary level health services in a district, the information regarding this is poorly represented in the district health database. As a result, the integrated district reports tend to be incomplete and not adequately represent the status of services provision in the district and consequently of the state. Urgent attention needs to be placed on correcting this gap, while also providing various other clinical, management and administrative support to the hospital doctors and administrators.

   There is thus a need for an "Integrated Open Source District Hospital Information System" with an objective to meet all three broad needs specified above and to evolve along with changing needs.

b. Hospital administrators take decisions on resource allocation – human and financial – and need to monitor functioning of all services and quality of care being provided.

c. Medical records forms an essential part of a patient's present and future health care, ad provides a collection of information about the patients health and treatment that improves quality of care and meets patients rights to know. A HIS will be used essentially for the present and continuing care of the patient. This would also contribute to medical research and production of health care statistics.

Features of a HIS

I. General

- Encompasses information gathering, knowledge management and facilitates decision making
- Provides health information infrastructure that helps in daily operations, clinical practice and ensures that quality services are provided to the patients in an efficient way
- Ensures an effective utilization of resources (human, capital etc.)
- Adheres to standards and leverages the latest technology developments in the health practice.

II. Clinical

- Provide integrated and comprehensive patient records of the patients to the doctors and to patients. This will also include the data from the name based tracking system for pregnancy and child immunization services
- Facilitate to achievement of better health care service delivery through integrated operational workflows sharing a common data structure.

III. Administrative

- Provide access and availability to operational Information to monitor performance of various units and to improve decision-making
- Facilitate in effective utilization of resources (human, capital etc.)
- In the long run, facilitate institutions in adhering to standards (IPHS, ISO etc.)

IV. Managerial

- Provide reports on hospital performance, quality indicators, revenue generation etc.
- Reports required for district health system reporting.

The HIS should comprise the following four broad modules: Clinical, Programme Information, Ancillary and Administrative Information system.

Clinical module comprises Registration, OPD, IPD, and details of maternal, child health, immunization details, family welfare services and disease wise data of treatment and cases, etc. At first all IPD cases and select few OPD cases will make electronic health record.

The Programme information module covers information pertaining to the national and state level programmes like RNTCP, NVBDCP, Blindness control, notifiable Infectious diseases, School Health, etc.

Ancillary module includes reporting forms for blood bank services, laboratory services, Inventory, Pharmacy details for drugs and other consumables; diet and laundry services.

Administrative information system module consists of RKS funds, Finance related forms for budget, profit and loss sheet; hospital quality of care indictors, service delivery measurement.

The HIS should comprehensively cover the key functionalities and processes within the hospitals as well as provides for an online reporting system for all health information.

Further specification of functions:

Patient Registration: Allows registering new patient for OPD, IPD and Emergency. Registration allows searching patients and avoiding duplication. It stores demographic and patient attributes. Also, the integration with the name based tracking system for pregnancy and immunization tracking.

Example: Checklists for Registration

- Identify patient categories and validatations
- Demographic details of patients
- List of Referrals
- List of OPD Rooms
- Categories for Free Bills
- Age and Sex
- Registers Maintained, by whom, given to whom
- Reports and Frequency of reports.

Billing: The billing module allows central collection of money for lab tests, radiology, drugs, in-patients care etc. The billing module can view ordered tests and drugs and create bills. It can create In-patient discharge bills as well as admission bills.

OPD: Allows creating observations for a patient by the doctor at the outpatient department. Observations for symptoms, investigations, diagnosis, and drug order can be recorded. Total attendance in each unit and for outpatient therapeutic procedure.

IPD: In-patient services like bed allocation, patient charts, nurses and doctor visit details can be recorded. Regimens, treatment and surgical procedures done on the patient can be recorded through this module.

Laboratory and Radiology: Lab management module is used to manage lab activities like test procedures, test stages and test results. Different processes of the labs and reports to be given to patients can be managed using this module.

Inventory Management: This module helps allow keep track of the entire inventory in the hospital including beds, blankets, utensils, equipment in the different departments. Different buffer levels can be set and notifications can be sent when the inventory is low.

Pharmacy Management: The pharmacy management is used to manage the inventory of drugs at the pharmacy. Drug dispensing to patients and their current availability can be monitored through this module.

Blood Bank Management: The blood bank management module is used for capturing details of blood bags, inventory of blood, patient request and dispensing etc.

Finance Module RKS (Rogi Kalyan Samitis - user charges): Finance related forms for budget, Income and Expenditure, Balance Sheets, Profit and Loss analysis.

Electronic medical record: An updated record for each patient is maintained and updated during each visit. EMR should be Accessible to providers, Accessible to patients at request.

6. The technical design document

The technical design document converts the functional design document into instructions and technical choices to assist developers for developing the software. These relate to IT and are not dealt with further in this book. Such a document is of limited use to health departments- which are more concerned with the functions than what happens at the back end. However, when it comes to third party certification of the software or reviewing the software, or developing it further in future, or even as learning for more use of IT in health care, the availability of such a document would make a large difference.

Section-5: Requirements through Prototyping

Traditional software requirements methodologies like software lifecycle methods are prone to limitations, because of their assumptions of linearity and that requirements can be "frozen". Reality is otherwise, and user needs constantly change and evolve, and software must by definition also evolve, especially in domains such as public health. Failure to do so will necessarily mean the death of the software.

In response to such critiques another approach to technology development based on a "participatory prototyping" has developed along with the growth of techniques based on what has been termed "agile development."

As health requirements are frequently changing and traditional software requirement methodologies have limited contribution. towards this problem participatory prototyping approach is more appropriate

Software prototyping refers to the activity of creating prototypes of software applications, i.e., incomplete versions of the "final" program being developed. A prototype typically simulates only a few aspects of the final solution, and may be completely different from the final product. Prototyping allows the software designer and implementer to get valuable feedback from the users early in the project. Prototypes focus on content and functionality and turn attention away from details such as of graphic design and attractiveness of display. They can compare if the software made matches the specification, and provides insights into the accuracy of initial project estimates and whether the deadlines and milestones proposed can be successfully met. It serves as a communication medium and facilitator between user and designer in the same way as a mock-up, and can be used as requirements specification. A prototyping process allows to understand tacit knowledge in a way that merely interviewing does not. Non-declarative or tacit knowledge implies the kind of knowledge that is not verbally expressible, i.e. users are not able to say what they know or what they think. The text-book example of such non-declarative knowledge is knowledge of how to ride a bicycle. Doing it may be easy but describing precisely how to do it is impossible. Prototypes thus allow you to do and express by working with the system, rather than to talk about it. Prototypes are evolutionary, meaning that a system evolves through multiple generations/prototypes succeeding each other. Thus, each prototype is an early version of the system that is further worked upon until the prototype has evolved into a finished system.

Participatory technology development

There are many sub-categories and approaches and steps to prototype development- horizontal, vertical, click dummy, extreme, throwaway, business etc.... We do not go into these here and the interested person can follow up with the references given. What is important to note is that this approach takes forward the understanding of participatory technology development. Which further means that this approach can take on board a number of disaggregated user preferences- including of gender and those of junior employees whose voices may otherwise not be heard in the technology development process.

Participatory design has a strong tradition within information systems, and has been dominant in open source systems since the seventies and eighties. Since participation is both a political and social process, it is shaped very much by the context. For example, in Scandinavia where principles of social democracy were dominant, user participation was even legislated through unions to enable workers to have a right to participate in decision making related to the introduction of technology in the workplace. The UK, coming out of the aftermath of the Second War promoted a form of socio-technical approach to systems development in which user participation was key. In the US, user participation was primarily towards supporting the development of more efficient systems.

In India, despite having strong traditions of participation in social movements, the practices of user participation in technology development is an alien concept. This is partly contributed to by the primary focus that the educational system gives on computer science and programming, rather than on the development of an information systems perspective that emphasizes the interaction between computer systems and organizations.

In the context of public sector systems such as for public health, the strong centralized control and command system that operates marginalizes any role to user participation in technology development leading to the implementation of systems that do not satisfy user needs and their subsequent failure. The recent efforts to introduce the tracking system for mother and child are another case in point. As we have shown in earlier chapters the logic of control overwhelms the needs of decentralized public health management- which is the key to health sector reforms for a credible public health system.

In the accompanying box, we provide an illustrative example of the use of participatory prototyping in the development of the DHIS, which has with a strong logic of public health inscribed in to supporting processes of user empowerment and control. The example also illustrates how the requirement process reflects the broader political agenda behind the system and the manner in which that is inscribed in the design.

Software development based on participatory prototyping: An example of DHIS

The first phase of DHIS development (1997-2001) can be characterised as an intensive three-year evolutionary process of participatory design, which took the system from a district pilot to a country-wide standard for Health Information System in South Africa.

To some extent, the prevailing post-apartheid reform goals of decentralization and local empowerment were consciously 'inscribed' into the software. Given the agenda of supporting the political change in South Africa, the software design process started out with a set of objectives and scenarios the design team wanted to inscribe in the software:

- Shift of control of data and information handling from central towards local levels, that is, toward more equal control between central and local levels.
- Local flexibility and user orientation—it should be easy to adapt the software to local conditions.
- Support for health sector reform towards decentralization and the development of health districts; that is integrating the vertical flows of data from various health programs at district level.
- Empowerment of local management, health workers, and communities—by providing access to their own data and data on their conditions.
- Horizontal flow of information and knowledge, based on the principle of free access to all anonymous, aggregated health data/information.

These objectives were translated into concrete inscriptions through key principles laid down during the development of the first prototype 1997/1998:

1. The application must support the hierarchy of essential data sets, that is, allowing users to add, modify, or delete local data elements, indicators, and so forth.
2. The application should be designed in such a way as to support the drive toward decentralised capture, analysis, and use of data—in particular, support the push toward having the facility staff responsible for data collection also doing data capture, quality checking, initial processing, and output.
3. The application should be easy to use for new areas (provinces, districts), and should allow users to tailor the geographic scope of their data sets to their needs. This resulted in the use of a front-/back-end solution in Access, where the back-end data files covered different geographical areas and the user can switch between them at will.
4. The application should as much as possible rely on the flexible and powerful analytical and display tools already available within Office 97, such as Pivot Tables in Excel, even if this increased the learning curve.
5. The application should be based on free (open-source) software—both gratis and with free distribution and redistribution of the source code.

The first DHIS application was developed in Visual Basic and Access. by core developers This prototype aimed at capturing and analyzing routine monthly data ('the MD module'), which was released for pilot testing in the HISP pilot districts in March 1998, and went through a series of very rapid prototype cycles during the next 4 to 6 months. New 'builds' were sometimes released on a weekly or even daily basis. The informal mechanisms for reporting bugs and requesting new functionality—all tightly integrated with user support—proved popular encouraged users to provide feedback to the development team. This combined with the rapid deployment of new or corrected versions astounded many users.

The development process went through several phases, emphasising performance and progress and rapid response to user demands over any established prototyping model. Within the institutional framework in which HISP was operating, consisting of a variety of hierarchical levels and organisational and political structures, more formally organised user participation would have been impossible or inefficient. Formal user groups would easily become

Software development based on participatory prototyping: An example of DHIS (Contd...)

battlegrounds due to the ongoing large-scale political transformations of South Africa's administrative structures. The methodology for participation and development used was, thus more informal and to a significant degree based on improvisation, whereby any interested or innovative user, regardless of his or her place in the hierarchy, had full access to the development team—a meritocratic approach. This access was either direct or indirect via the other DHIS trainers/facilitators, and users were encouraged to use whatever channels they preferred.

After the first phase of very rapid prototyping, the user base increased and the software and user requests stabilised, and releases of versions became more controlled, and super users in advanced and early districts and provinces were used to test new versions before national releases. By 2001, the DHIS was implemented in all provinces and districts in South Africa, as the national standard.

Section-6: Selecting a Technical Support Agency

It is not within the internal capacity of a health department to develop the software it requires. It would therefore have to procure the services of an agency to develop the software.

The first and most important part of such procurement is to define the software and support requirements for which the agency is being hired. This to be determined and written up as a proposal document- as discussed earlier. Such a proposal document would have a statement of the needs and the objectives of the software solution sought, as well as the context of use and timelines and the subsequent support services needed. One must also specify the standards that the software must conform to. The proposal document and preferably made a public document is which other experts can comment and contribute. Then, based on this, bids are invited from IT development agencies.

One could also consider whether one wants the agency to also assist with other aspects of the information systems –like capacity building, hardware development etc. but usually these are kept separate.

One issue is whether to make an a priori choice between open source and proprietary solutions. Some states have exercised such a policy option. Both types of software have their strengths and their problems- but if we are starting small and intending to scale up, open source has the advantages of not requiring licenses. Also open source lends itself to constant development. Proprietary solutions may be more suited for one time, one facility use.

One problem with IT recruitment is that the prices quoted can vary very widely and it is different to measure quality and relate it to price before the work begins. Government rules try to address this problem by asking for a separate technical and financial bid. Then the technical bid is opened and scored. Then the financial bids are opened., only for those who got the minimum required technical score. The lowest bid wins irrespective of the technical score. Another way - called the QCBS method- is to integrate

the technical score with financial score- by a process which is weighted in favour of technical scores- and decide the winner.

However objective assessment of technical score becomes a problem and many non serious agencies could easily qualify. To overcome this problem, governments often set eligibility criteria or scoring criteria that is meant to eliminate the in- experienced and the non serious.

One way government seek to achieve this end is to set very high turnover rates as an eligibility criteria or as a major scoring criteria, so as to allow only large firms to participate. The problem is that though the very large firms win the contract, since for them the contract is a relatively small amount, the persons they depute for this job, may not have the requisite experience and it is difficult to prevent this. Also one may just be paying much higher than is needed. Further this inherently eliminates most open source solutions which are almost by definition, low budget operations. Since open source has special advantages in this game, eliminating such agencies by entry turnover criteria is clearly unwise and even unfair.

The second way of ensuring better players is to ask for specific forms of software development accreditation. Again these have not worked very well, for technical persons within accredited firms turn over rapidly and because much of the accreditation criteria are not relevant to the work at hand. Also accreditation of developers for open source has not developed well.

Our way to address the problem of an objective, fair and relevant technical merit assessment is by basing it on evaluation of the previous work of shortlisted agencies. Of course it would have to be relevant work- and it would have to be independent evaluation of the developed software against the same set of documents- functional design, technical design and proposal documents that we have discussed in this chapter. But with such assessment objective technical evaluation and with assurance that the same persons who did the earlier project are still on the team, there would be better scoring of technical merit. And then- the financial bids could be opened and in a government process we would go by lowest quote or in the QCBS process go by an integrated score weighted in favour of technical merit over financial merit. (this process is well known and not described here).

Once the contract is awarded the agency must develop and get approval for both the functional design document- with its three sections on Needs, Features, and Software specifications as well as the technical design document. Then the first major installment is paid and the work begins.

If however a prototype development approach is chosen, since it is decentralized, one could allow a number of shortlisted developers to work in different sites and then scale up those whose prototype meets the requirements best. Agencies may develop software de novo or adapt existing ones- the choice is theirs. Many universities and research institutions could

participate in such prototype development, in which case once the prototype is ready and field tested, it could be scaled up through the commercially oriented bidding process. The advantage of using such non commercial agencies for prototype development is that instead of competition and secrecy between the various developers there could be cooperation and synergy. The disadvantage would be that they would not have the same pressure on timelines and quality of product, that a commercial agency would feel. Also current procurement rules of the government would need to be interpreted with considerable flexibility and understanding, if a number of developers have to be financial for developing the same product.

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