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Original article  
**Bhorugram (India): revisited**  
A 4 year follow-up of a computer-based information system for  
distributed MCH services

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**Abstract**

Impact of a health informatics research project on the management and delivery of primary health care, focusing on maternal and child health care (MCH), was reported earlier in 1992, with encouraging results in terms of increased antenatal care coverage and decrease in Immunisation drop-outs. The software (MCHS) was based on essential data sets (EDS) to assist the care providers in information management for MCH care. The site was revisited after four years to evaluate the status of the project and to ascertain whether computers were still in use and was the dispensary staff using the MCHS package or not? The results are presented in this paper to demonstrate that 'information is a difference that makes a difference'. Information generated by the MCHS acted as a catalyst for behavioural change in the community from indifferent users to active users of the health care services. This is reflected by the increased acceptance of antenatal care, 80% fully immunised child (FIC) and participation in other primary health care activities. © 1997 Elsevier Science Ireland Ltd.

*Keywords:* Primary health care; Information systems; Epidemiology; Immunisation; Maternal health services

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**1. Introduction**

A computer based information system project supporting maternal and child health care was implemented in a dispensary, delivering primary health care, located at Bhoru-

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gram, India in 1990. Baseline survey reported a drop-out rate of 72% in the immunisation program and lack of antenatal care in the area [1]. The information system impact on the management and delivery of maternal health care was reviewed in 1992 with encouraging results [2].

The Bhorugram site was revisited after a span of 4 years to see if the earlier results were 'transient or even illusory events' regressing in the face of adverse conditions such as financial constraints or frequent turnover of the physicians in the dispensary. Thus, sustainability was an important criteria of success [3] while evaluating this project.

Maternal and child health care (MCH) and related family planning and immunisation comprise one of the strongest fundamentals of population health. It is also well-known that integration and distribution of MCH within the regular, preferably primary health care organisation is decisive for progress. However, success has been limited, as specifically investigated and discussed regarding the essential immunisation part in a number of internationally recognised studies lately. Two of the most representative of them will be quoted here, one concluding that lack of attendance was due to communication deficiencies by the provider site [4], the other blaming the recipients for the same failure [5]. The truth, as suggested amongst others by WHO [6–8] and extensively verified by a Swedish–Indian research group [1,2,9–18] is that the information system per se is the foremost missing link. With a timely and up-to-date microcomputer information system [2,9,12,14,15] based upon an essential data set (EDS) for MCH services [1,2] their performance, including the crucial immunisation part [14,15] improves markedly and durably, resulting also in substantial economical gains [15].

Immunisation has been practised for the past 200 years but, until the past few decades, had only a marginal effect on the protection of populations against infectious disease. The elimination of the great killer, smallpox, was a major achievement of the immunisation program. Immunisation has proven an effective determinant of childhood health [19,20]. Not only is immunisation effective, it is also cost-effective [15]. Economic analysis of the US measles and rubella program in 1981 suggests the costs incurred by the diseases were 15 and 11 times greater than costs of the respective programs [21]. Immunisation is now the most widely available health service throughout the developing countries and the outreach developing for immunisation has been used to strengthen and deliver other areas of primary health care [22].

This paper reports the sustainability of primary health care informatics project initiated in 1990 in spite of frequent turnover of the physicians at the Bhorugram dispensary. Most of the physicians had a short stay ranging from 1 to 6 months due to the rural environment and 'harsh' climate of the desert. Only, one physician spent more than a year between 1994 and 1995 in the dispensary. In the absence of the physicians, the community health workers (CHWs) and the auxiliary nurse midwives (ANM) concentrated on the immunisation program by monitoring the drop-outs with the help of the computer operator. The CHWs and ANMs, however, did not use the module for maternal health care except for registration of antenatal cases. At the level of the ANM and the CHW, the antenatal care comprises of identifying the pregnant women, providing iron tablets and immunising them against tetanus.

The critical role of the 'grassroots' workers CHW and the ANM in delivery of primary health care and as a link between the community and care providers at the primary health

care centre has been accepted universally. The high percentage of fully immunised child (FIC) status in immunisation program reflects on the efforts made by the health workers in motivating the community. The links forged between health workers and communities served to raise the profile and status of these health workers.

## 2. Materials and methods

### 2.1. Site

The dispensary at Bhorugram is now a 20 bedded referral rural hospital with facilities such as X-ray, pathology laboratory and operation theatre. The Thar desert remains as hostile as ever with its typical desert climate (hot summers and cold winters). The lack of roads still exists but the transport services in regards to number of buses has increased which still are overloaded. The camel cart remains the most effective 'ambulance' transport in emergencies (Fig. 1).

### 2.2. Clientele/community

The referral rural hospital at Bhorugram is catering to the needs of 40 villages with a population of 49 137 (1991 census) which is



Fig. 1. Camel cart.

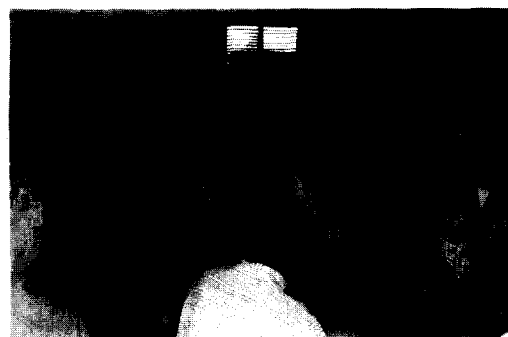


Fig. 2. Women at a meeting.

scattered in radius of 20 km. Most of the villages (42.5%) have less than 1000 population whereas 30% of villages have a population of over 1500. There are five villages (12.5%) within 5 km distance from the hospital and 28 villages (70%) more than 10 km distance. Most of the villages now have electricity supply and 'kucha' roads. The population is mostly illiterate with literacy rates being approximately 28 and 19% for males and females respectively. 'Purdah' system is prevalent in the society, where women cover their faces with cloth when in public places (Fig. 2). The distribution of the population shows a large dependency ratio: about 39% of the population are in the age group below 15 years and only 38% constitute the work force. Most of the population in this area is involved in agricultural work.

### 2.3. Manpower and other resources

The hospital is supposed to have at least four physicians (surgeon, internal medicine and two general practitioners), however, at an average, there are only two physicians. The other staff includes community health workers (CHWs) (3), auxiliary nurse midwives (ANMs) (3) and ambulance drivers (2). A computer trained operator is responsible for the computers which now include

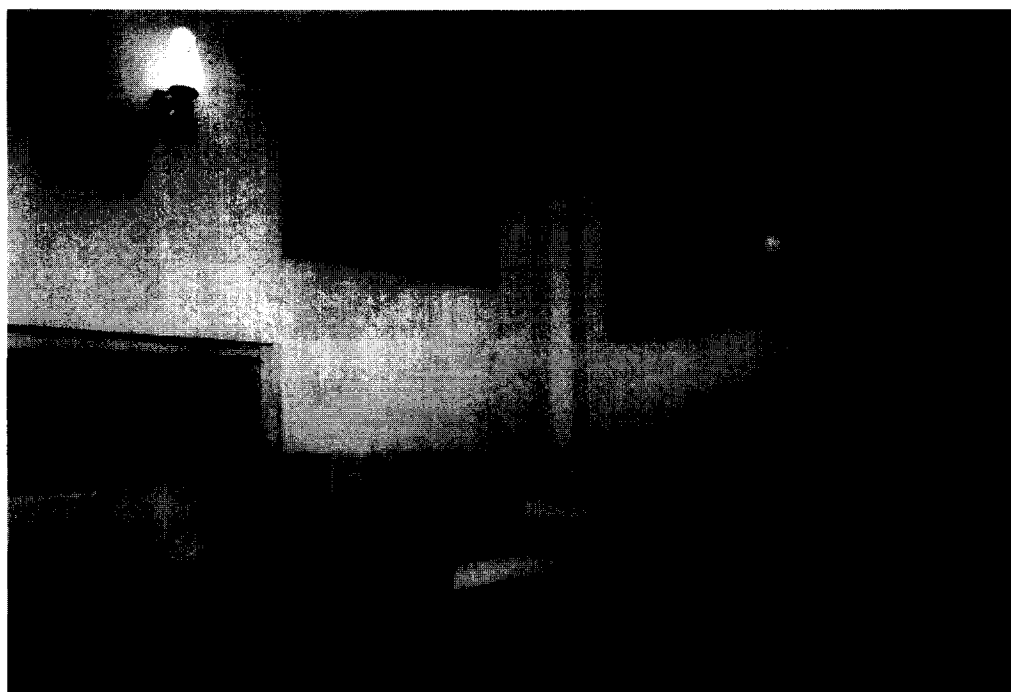


Fig. 3. Computer room.

Intel486 based PC (1) and Intel-386 based PCs (3) with Dot Matrix printers (Fig. 3) as compared with the earlier PC/XT with 360 KB floppy drive. Besides health care monitoring, the computers are used for day-to-day office work of the Bhoruka Charitable Trust (parent organisation involved in rural development). The hospital renders primary health care through outreach services.

#### 2.4. Method

The project site has been visited regularly since May 1996 by the authors. A health team comprising of a physician, an ANM and a CHW visit a couple of villages on a 'fixed' day every month, in case the physician is not available the ANM assumes the leadership. The village contact is the voluntary female health worker. The data recorded by the health team is given to the

computer operator for data entry, which is done in 'batch mode'. Feedback in form of various lists of drop-outs are given to the health workers for the next visit to follow-up.

### 3. Results

The baseline survey conducted in 1990 in six villages showed drop-out rates in immunisation to be 72% and there was hardly any antenatal care activity. The fully immunised child (FIC) status over the last 4 years from 1992 to 1996 has shown a steady increase from 45.4 to 81.9% in the DPT vaccine and from 46.07 to 77.7% in the oral polio drops vaccine (see Tables 1 and 2).

The antenatal registration has shown an increase from 384 to 705 in 1996. The tetanus

Table 1  
Fully immunised child (FIC) DPT vaccination

Year	DPT-I dose	DPT-II dose	DPT-III dose	FIC (%)
92–93	700	494	318	45.4
93–94	811	760	630	77.6
94–95	794	671	603	75.9
95–96	874	712	716	81.9

toxoid vaccination in the ANC cases has shown a drop-out rate of between 45 and 50% (Table 3).

The registration of births during this period has increased from 216 to 944 in 1996, still births are included in the total (Table 4). The discrepancy between the ANC registered cases and actual births being registered reflects on the acceptance of the ANC activity and other social factors like the first delivery is generally conducted in the pregnant lady's parental home not in the in-laws home.

The acceptance of various family planning methods shows an increasing trend. The permanent sterilisation camps are organised by the government agencies, hence in case the camps are not held like in 1994 the figure shows a downward trend (Table 5). The most acceptable is Nirodh (condom), followed by the oral pills. Permanent sterilisation include tubal ligation and vasectomies.

#### 4. Discussion

Alvin Toffler in his book 'The Third Wave' had predicted that "the arrival of the computer is not only likely to bring in revolutionary changes in various walks of human endeavour. Even lifestyles will change. In such a highly complex society, information would be the most valued and essential property. Knowledge would be power in the real sense of the phrase". Information is a highly

valued resource today which is capable of generating 'awesome' power.

Health care activity being information intensive is prone to computerization [23,24]. The computer is, also, now being increasingly recognised for what it really is in the anthropomorphic reference; faithful book-keeper, which may swiftly support and serve the decision-making, work and accounts of the autonomous users—provided that it is equipped with the right directions and instructions.

The application package (MCHS) was developed with the help of end-users to help them manage their health care activities, thus it may be termed as an 'action-led' rather than 'data-led' information system. Through the information generated by the application package and combined with the other social and development factors, the society has been transformed from an indifferent user to a concerned user of health services. The reports generated by the MCHS specially regarding the follow-up of immunisation drop-outs were used by the health workers to communicate health information to the society. The feeling of 'being' cared for by the health care providers motivated and brought about the change in the community.

This change is reflected in the results showing an increase in the FIC from 28 (1991) to 81.9% (1996) (Tables 1 and 2). The concentration of the health care providers on successful immunisation has had many fold effect on the global call for 'health for all by the year 2000'. The first and the foremost

Table 2  
Fully immunised child (FIC) oral polio drops vaccine

Year	OPV-I dose	OPV-II dose	OPV-III dose	FIC (%)
92–93	714	504	329	46.07
93–94	873	790	680	77.8
94–95	828	698	624	75.3
95–96	894	779	695	77.7

Table 3  
Antenatal registration and tetanus toxoid vaccination

Year	Total registration	Tetanus toxoid I dose	Tetanus toxoid II dose	Drop-outs from I dose (%)
92–93	384	374	200	46.5
93–94	590	590	343	48.6
94–95	586	527	388	26.1
95–96	705	586	296	49.4

effect is the involvement of the population of 40 villages in the health care process. Secondly, the status of primary health care workers has improved as a result of their immunisation activities, this fact has also been reviewed [22]. Thirdly, the administrators have utilised the outreach services involved with immunisation to strengthen other primary health care activities such as antenatal care and family planning (Tables 3–5).

The village health volunteer along with the primary health care workers have been able to enumerate the target population by house-to-house survey and have established a system to identify, trace and follow-up every

Table 4  
Registration of births

Year	Total births	Still births	% still births
92–93	215	1	0.46
93–94	620	18	2.9
94–95	911	12	1.3
95–96	941	3	0.3

child born in the community, this in itself is the basic principle of public health. The antenatal care has increased from a zero base to 705 in 1996. This figure is far short of the expected coverage (1800) which is calculated as follows; in a total population of approximately 49 000, the distribution of the population would be 39% below the age group of 15 years and eligible couples would be in the range of 15–20% (6000–8000). The expected births in the area as per the current birth rate of 27 per 1000 population would be around 1800 to 2000 per year. Hence, it is but expected that over a period of time and with increasing participation of community in the health system this target would be achieved.

One major benefit of the computer based information system has been economic. We had earlier reported from our pilot efforts the financial savings accruing from an improved immunisation coverage [15]. During the initial baseline survey prior to the implementation of the system in 1990 a drop out rate of 72% in the immunisation programme was

Table 5  
Family planning

Year	Nirodh (condom)	Oral pills	IUD	Sterilisation
92–93	370	63	3	107
93–94	572	168	12	87
94–95	787	571	26	249
95–96	1014	647	7	141

This is supported by the overall Rajasthan statistics, e.g. of FIC, which were and have remained on the same level as in Bhorugram 1991–92 [25].

recorded. These drop outs, in financial terms, translated to an increase in the cost of a fully immunised child (FIC) from the standard US\$ 15 to US\$ 54 [15]. Using similar calculations on the immunisation figures reported in Table 1 the costs of a FIC have dropped from almost US\$ 33 in 1992–93 to US\$ 18.31 in 1995–96 (Table 6).

Another subtle benefit of the information system is the availability of information about the local population. This has assisted the health care workers and the social workers in the area to project their case strongly with genuine facts and figures. This has led to increased support for social and health care projects in the area, e.g. eye camps (cataract surgery), construction of low cost sanitary blocks, low cost housing, etc.

One drawback with the present study is the lack of comparable control populations. It may well be asked whether the computer based information system can be given credit for improvements in the immunisation programme

performance or improved antenatal registrations. The area under study is a remote rural area and no reliable population, epidemiological or health related data is available to allow comparisons. Under the circumstances we have compared our observations with the historical data recorded during the baseline study which was carried out before implementing the computer based information system. These comparisons and the trends over the past 4 years show a gradual improvement in immunisation statistics and antenatal registrations. One can thus reasonably assume that the computer based information system was to some extent beneficial in the primary care process. This is supported by the overall Rajasthan statistics, e.g. of FIC, which were and have remained on the same level as in Bhorugram 1991–92 [25]. The availability of accurate statistics even when they are not flattering, as in the case of drop outs in tetanus toxoid immunisation (Table 3) and poor sterilisation performance (Table 5), is a further testimony to the usefulness of the system.

Table 6  
Estimated costs per FIC

Year	No. in cohort	Estimated cost at US\$15 per FIC (\$)	No. in cohort received 3rd dose	Loss due to drop outs (\$)	Revised FIC (\$)
92–93	700	10 500	318	5730	33.02
93–94	811	12 165	630	2715	19.31
94–95	794	11 910	603	2865	19.75
95–96	874	13 110	716	2370	18.31

## 5. Conclusion

Primary health care is a cost-effective method to deliver health care to the population and has been accepted as such by the Member States of the WHO. Its full potential will only be realised if there is information to support the program management. The point of mass contact, namely, the primary health care centre, is the place computerisation will benefit the masses the maximum [12]. Implementation of such health information systems should be in a modular manner, starting with the immunisation program, so that, the confidence level of both the community and the primary health care workers is built up. This module should be followed by module supporting maternal health care and family planning.

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