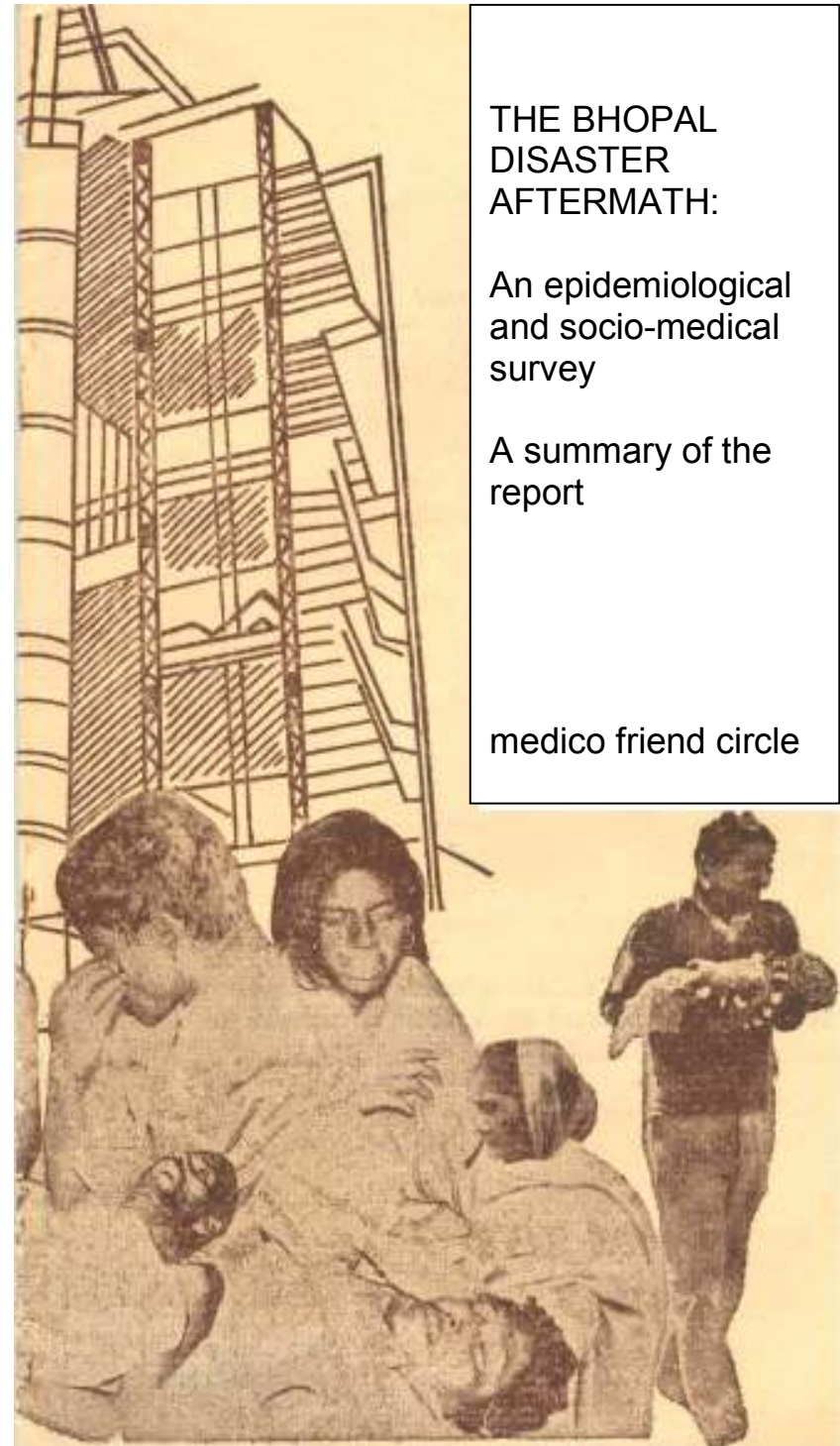


THE BHOPAL  
DISASTER  
AFTERMATH:

An epidemiological  
and socio-medical  
survey

A summary of the  
report

medico friend circle



*Dedicated to the thousands  
who died or were disabled  
by the Bhopal Gas Disaster --  
one of the worst industrial  
accidents in recorded history.*

*With a resolve*

*to prevent medical research from  
becoming an instrument of  
exploitation of human suffering*

*With a determination*

*to make medical research  
an expression of  
human concern*

**A summary of the epidemiological and socio-medical  
investigation conducted by a team from the medico friend  
circle, in Bhopal, 18-25 March 1985**

Price Rs. 2. 00

## PREFACE

The Bhopal disaster has been an unprecedented occupational and environmental accident. Equally unprecedented have been the imperatives for relief, rehabilitation and research in the aftermath of the disaster.

The local situation has been extremely complicated and dynamic. While health service providers and researchers have had to face many medical challenges; government and voluntary agencies involved in relief and rehabilitation have had to face many logistical and organizational challenges.

For the medico friend circle too, in its intervention in research and continuing education strategies in support primarily of voluntary agencies, it has been both a challenge and a thought provoking learning experience. The experience of planning, organising, analysing and communicating our research findings based on a modest study has brought us further in touch with the apathy, vested interests and status quo factors which obstruct action in favour of the disadvantaged in society.

Having seen the intensity of health problems of the disaster victims and the inadequacies in the strategies employed to ameliorate them we cannot but help raise critical comments on all components of the social medical system who are there to handle such problems.

Our objective, however, is more than critical analysis. Through this epidemiological study we have tried to make our own small contribution to a better understanding of the health problems that prevail in the aftermath of the disaster. We have also made suggestions for a more comprehensive relief and rehabilitation strategy.

A word of caution here-most of our observations are of the situation as it existed at the end of March 1985. Six months have passed in the process of analysis, consensus

seeking and understanding our findings. During these six months many further developments -- both positive and negative-- have taken place in Bhopal at the governmental and the non governmental initiative.

We hope that this report will atleast help to highlight to our readers among other matters that-

- (i) what people say and feel is as important evidence as what we can discover through our over-mystified medical technological approach;
- (ii) in the absence of a community oriented epidemiological perspective, decision making about relief efforts following a disaster can be adhoc and often irrelevant; and
- (iii) for research to be relevant to the lives of the people, the findings and inferences drawn must be communicated to the health service providers and the patients themselves through an effective communication strategy.

Finally we hope that through this report, we shall stimulate debate, dialogue and a commitment to a deeper understanding of the problem leading to more relevant and meaningful interventions.

Bangalore  
2 Oct. 1985

Ravi Narayan  
Convenor

## **THE BHOPAL DISASTER: ITS AFTERMATH**

### **Introduction**

The disaster that took place on the dark, wintry night of 2/3 December 1984 in Bhopal is the worst man made environmental accident in recorded history. The shocking, official estimates of 1754 human deaths, an equal number of dead cattle and the physical and mental disablement of over two lakhs people, by a mixture of toxic gases including Methyl Isocyanate (MIC), do not adequately express the tragedy that has occurred.

The relief efforts, initiated immediately, were handicapped and hampered by the lack of authentic information on the nature of the gases released, by the unwillingness of the Union Carbide to release information and by lack of relevant information among the State and Central authorities.

The doctors at the Hamidia Hospital, Bhopal, where hundreds of the victims rushed, were faced with an acute emergency which they never anticipated, of whose exact nature they had no inkling, and for the treatment of which they had no ready sources of information.

Since the nature of the toxic gases released into the atmosphere had not been made public either by the Union Carbide or by the Centre (which sent high level technical experts to Bhopal), this had to be a conjecture based on reason and visible evidence.

Soon, two theories emerged to account for the varied symptomatology and stunning mortality of the victims. The development and testing of these theories, had they been done properly, would undoubtedly have added immensely to scientific knowledge. What is more important is that it would have relieved the sufferings of thousands of people. The local realities have, however, revealed the power stru-

gges in the medical community and how it ignores in the process, the victims; the lack of human concern leading to withholding of probable proper treatment; the indifference of our medical and scientific community to communicate with our largely illiterate but not unintelligent masses.

#### The Two Theories

The protagonists of the first theory, the '*Pulmonary theory*' believe that isocyanates of which MIC is one, damages only those tissues with which they come into direct contact and cannot be carried by the blood to internal tissues and organs. Thus MIC can damage only the lungs, eyes and skin and this according to them explains the predominant involvement of the eyes and lungs in the Bhopal victims. They also believe that symptoms, if any, related to other systems must be due to hypoxia caused as a result of lung damage. This theory is strongly supported by a dominant section in the Gandhi Medical College and the medical community in Bhopal. They believe that early deaths were due to carbon monoxide poisoning - one of the constituents of the released gases. They refuse to accept any alternative theory.

This theory cannot fully explain the varied symptoms of the victims: nor the fact of multi-systemic involvement without lung involvement seen in many patients. While another isocyanate, toluene diisocyanate (TOI) has been shown to cause brain damage, the protagonists of the present theory are silent as to why MIC cannot do so, too. Public Health specialists in the U. S. say that this exposure can lead to permanent lung involvement and blindness. This is in contrast to the Union Carbide which maintains that MIC can have no lasting damaging effects.

The main protagonist of the second theory, the '*Enlarged Cyanogen Pool theory*', is the Indian Council of Medical Research (ICMR). In fairness to this body, it must be stated at the very outset that it does not reject the first theory

but believes that both have important roles to play in explaining the varied symptomatology.

This theory stemmed from the observation that the tissues and blood of the dead victims were bright red in colour. This occurs both in cyanide and carbon monoxide poisoning. Haematological (blood) studies by ICMR ruled out the possibilities of carbon - monoxide poisoning.

Cyanide on the other hand might have been inhaled directly as hydrogen cyanide or might have been released in the body after the breakdown of the MIC molecule.

Normally, there is a small cyanogen pool in the body formed by the generation of small amounts of cyanide or cyanogenic substance during normal metabolic processes. These cyanide or cyanogenic radicals are converted into relatively harmless thiocyanates by a liver enzyme called rhodanase and excreted in the urine. Certain foods like cabbage etc., and smoking are known to increase the cyanogen pool as evidenced by an increased excretion of thiocyanates in the urine. Cyanide/cyanogen interferes with oxygen utilization in the body.

The protagonists of the enlarged cyanogen pool theory have established that MIC in the body gets attached to the haemoglobin by a process of carbamylation. They believe that by a mechanism as yet unknown the cyanogen pool within the body is increased. In these circumstances, its conversion to thiocyanate by rhodanase, can be accelerated by administration of sodium thiosulphate (NTS). This is the rationale in using NTS as an antidote for cyanide poisoning. The resultant thiocyanates are excreted in urine, and this can be used to test the proposed theory itself.

The ICMR conducted a double blind clinical trial using sodium thiosulphate and glucose as a placebo on gas affected patients in January. Majority of patients who received NTS showed significant improvement and 10 out of the 19

patients showed an eight fold increase in urinary thiocyanate levels. Those who received glucose did not show significant changes. Unfortunately, and due to reasons best known to itself, the ICMR has not made the details of the findings of this crucial trial, public. The opponents of the theory too have conducted a trial-not double blind, which they say does not confirm the hypothesis. They too have withheld their findings from public scrutiny.

### **The Study by mfc**

The mfc had decided at its annual meet held at the end of January 1985, to respond to a series of appeals from various non-governmental organizations(NGOs)and citizen's forums to undertake an epidemiological investigation, so as to support the victims and the NGOs in their struggle for proper relief and a more meaningful rehabilitation process:

Some members of mfc visited Bhopal in mid-February to assess the situation and the actual epidemiological survey was conducted between 18-25 March 1985 by 11 members of mfc and 3 friends from the Baroda Medical College.

It must be admitted that the mfc had neither the human power nor the material resources to launch a full scale investigation. Our initial, fact finding survey revealed:

- (i) official secrecy regarding all information on the disaster;
- (ii) absence of open scientific debates;
- (iii) lack of encouragement to NGOs. The mfc therefore decided to:
  - (i) make an epidemiological assessment of the current health status and health problems of the people;
  - (ii) to examine the findings in the light of the two controversial theories;
  - (iii) to evolve a critique of the medical reasearch and relief programme;

- (iv) to make recommendations for a more meaningful relief and rehabilitation policy.

The ICMR summaries of research undertaken and press releases available to us were inadequate and sketchy. We decided that we would go primarily by the broad range of symptomatology with which the patients in the community were presenting. We supplemented this by a thorough physical examination and undertook haemoglobin estimations and lung function tests. A criticism against this approach of reliance mainly on symptoms could be that it lacks objectivity. However, we believe that a thorough study of symptoms is a perfectly valid method of study as has been accepted in a whole range of medical conditions like chronic bronchitis, ischaemic heart disease, arthritis etc.

### **The study population**

The study was a community based, case/control study.

Two slums were selected for the study: (i) *J P Nagar* situated in the close vicinity of the Union Carbide factory and the worst affected by the gas leak. (ii) *Anna Nagar* 1 0 km away with the least exposure, which served as the control. There was no area which was similar to JP Nagar in socio-economic and environmental characteristics and yet escaped exposure and, therefore, Anna Nagar with the least exposure was the best control that could be chosen.

Rapport was established with the people by explaining to them our objectives and making it very explicit that we were not there to offer any financial compensation, medical treatment etc. The slum dwellers were given a hand out in Hindi explaining the role of mfc and a commitment was made that the salient findings of our study and our recommendations would be made available to them.

### **Sample Selection**

The families for study were selected by random sampling, an accepted statistical method used in community-

based studies. Only subjects above 10 years of age were selected. Those less than ten years were excluded in view of their probable inability to report symptoms correctly. All details were entered in a pre-designed proforma. In addition, lung function tests were done by standard procedures using a portable *spirometer* by a doctor fully familiar with measuring these under field conditions.

### Observations

The two slum populations were similar in age and sex composition, in the number of smokers and of people with long standing respiratory problems like asthma, tuberculosis etc. The JP Nagar residents who were the more affected, were slightly better off economically but this is of no significance in so far as morbidity rates in JP Nagar are concerned. *(For details of actual figures, see our Report.)*

An unexpected finding was that people as far away as Anna Nagar (our control population) were minimally exposed and we observed a larger number of serious symptoms in this group than one would expect. This fact narrows down the differences in rates of symptoms observed between the two populations. The health impact of the toxic gases on the exposed population is therefore much greater than what our study reveals.

The subjects described *a broad range of symptoms arising from most of the different systems in the body*. Each symptom was described in such graphic detail that it was obviously based on the patient's own experience and could not be malingering or wild imaginations as some are apt to allege. Since these symptoms could arise due to different causes and since the residents of Anna Nagar, the controls, were also exposed to the gas, albeit to a small extent, the latter also reported those symptoms. However, *JP Nagar residents had a much higher (statistically highly significant) incidence of these symptoms compared to Anna Nagar.*

The commonest symptom was breathlessness on accustomed exertion. The following symptoms were highly significantly different (higher) in JP Nagar as compared to Anna Nagar: cough with expectoration, chest pain, blurred vision, photophobia, headache, fatigue, loss of memory for recent events, weakness in extremities, muscle ache, abdominal pain, nausea, and anxiety/depression (see table). The following six symptoms were also significantly different: dry cough, breathlessness at rest, watering of eyes, skin problems, bleeding tendency, and impotence. On grouping the symptoms according to the systems, most of them are related to the pulmonary system (respiratory), the gastrointestinal system (digestive), the eye and the central nervous system. It is important to note that this survey was conducted more than three months after the disaster, and the victims still continued to suffer so many multisystemic symptoms. *Moreover every individual in the JP Nagar sample reported at least one serious symptom* but many in the Anna Nagar sample did not report any such. *Probably the most crucial finding of significance was that 35% of the patients had gastro-intestinal, central nervous system and eye symptoms in the absence of any lung findings.* This cannot be explained by the theory that the multisystemic symptoms are due to hypoxia (decrease of oxygen in blood stream) secondary to lung damage. It points to the possibility of a circulating toxin in the blood, affecting all the systems.

*Our findings also refute the speculation that much of the present morbidity is due to a high prevalence of chronic diseases like tuberculosis, asthma, bronchitis etc., and high rates of smoking among the affected basti population.*

*Women in the reproductive age group* reported menstrual irregularities such as shortened menstrual cycles, altered pattern of discharge, pain during menstruation and excessive white discharge. These symptoms were compared not only between the two populations, but also with respect to the

pattern in the same group before the gas disaster and the difference was found to be statistically significant.

Nearly half of the nursing mothers in J P Nagar reported a decrease or complete failure of lactation.

8% of the men reported impotence.

The number of pregnant women in the sample is too small to come to any conclusion about the effect of the exposure on the outcome of pregnancy. We are conducting a detailed study of pregnancy outcome in September 1985.

Many residents had symptoms of anxiety, and some had frank depression. Many had loss of memory for recent events.

Mean pulse rates and respiratory rates were not significantly different in both sexes in JP Nagar and Anna Nagar. Mean haemoglobin concentrations in both males and females were significantly higher in JP Nagar than in Anna Nagar, suggesting that compensatory mechanisms in the body had begun to respond to the hypoxia.

The mean values of lung function tests were statistically significantly lower in JP Nagar as compared to Anna Nagar particularly in the age group 15-44 and 45-60 in both sexes. The pattern was primarily restrictive.

*An important finding of grave significance is that 65% of the working persons in JP Nagar experienced a drop in income ranging from 20% to 100% as opposed to only 9% in Anna Nagar.* This reflects the way in which the physical/ mental disability of the people caused by the disaster has affected their working and earning capacities.

#### The causative factor

The presence of such varied symptoms suggests the involvement of more organs and body systems than the lungs alone. These cannot be explained by the pulmonary

Sl No	Symptom	J P Nagar	Anna Nagar	P Value
1	Breathless on usual exertion	87.16	35.50	<< 0.001 (129) (49)
2	Chest pain/tightness	50.0	26.08	<< 0.001 (74) (36)
3	Weakness in extremities	65.54	36.95	<< 0.001 (97) (51)
4	Fatigue	81.08	39.85	<< 0.001 (120) (55)
5	Anorexia	66.21	28.26	<< 0.001 (98) (39)
6	Nausea	58.10	16.66	<< 0.001 (86) (23)
7	Abdominal pain	53.37	25.39	<< 0.001 (79) (35)
8	Flatulence	68.91	25.36	<< 0.001 (102) (35)
9	Blurred vision/photophobia	77.02	38.40	<< 0.001 (114) (53)
10	Abnormal distant vision	42.0	21.88	<< 0.001 (65/141) (21/96)
11	Loss of memory for recent events	45.27	11.59	<< 0.001 (67) (16)
12	Tingling & Numbness	54.72	20.28	<< 0.001 (81) (28)
13	Headache	66.89	42.02	<< 0.001 (99) (58)
14	Muscleache	72.97	36.23	<< 0.001 (108) (50)
15	Anxiety/depression	43.92	10.14	<< 0.001 (65) (14)
16	Impotence	8.10	0.72	< 0.05 (12) (01)
17	Haemoglobin (male) (mean gm%)	14.68	12.70	< 0.01 (1.79)* (1.35)*
18	Haemoglobin (female) (mean gm%)	12.7	10.79	< 0.001 (1.46)* (1.34)*

\* Standard deviation of means

**Salient Findings of the Study**  
**Comparison of symptoms/investigations in J P Nagar and Anna Nagar**  
 (expressed in percentage) (No. of cases are shown in brackets)

theory alone even though pulmonary lesions can cause peripheral hypoxia and hence muscular fatigue and so on. On the other hand, the enlarged cyanogen pool theory can better explain the varied and apparently unconnected symptomatology. It must be emphasised that both theories are probably playing a role in the causation of symptoms. However, the ICMR has not tested the cyanogen pool hypothesis rigorously. It has studied only the seriously ill, hospitalized patients and concentrated mainly on the lung symptoms. They do not say whether the non-pulmonary symptoms (symptoms not related to lungs) were also relieved by sodium thiosulfate and curiously has not made its findings public. One therefore, may also question whether the cyanogen pool theory is fully valid.

It must be stressed here that the mfc is not rejecting the cyanogen pool theory. It is only to point out that the country's main medical research body has failed to be rigorously scientific in testing its own hypothesis.

#### Sodium thiosulphate therapy

We have already explained how sodium thiosulphate (NTS) will help remove cyanide radicals from the body. If the enlarged cyanogen pool theory has been established, even as one of two causative factors the victims should receive NTS treatment. Some of the local doctors and bureaucrats availed themselves of this, after the cyanide theory was proposed, yet the affected people in the bastis were not given the drug.

The ICMR at a meeting held on on 4 Feb 85, issued guidelines for NTS treatment. The medical group of Bhopal which was opposing the treatment, was also present at the meetings, according to the minutes. Yet they opposed the treatment later with the argument that they are not convinced of its efficacy. The question is not of a doctor's conviction. A doctor's choice of treatment cannot be arbitrary. The

question is whether there is scientific evidence in favour of NTS therapy and whether there is equally strong, if not stronger, evidence against the use of NTS in this situation.

NTS with its specific action is a better therapeutic agent than the non-specific remedies that are being used for the lung symptoms. A dominant section of the doctors of Bhopal are thus guilty of delaying treatment and by not revealing the findings of its clinical trial, the ICMR too has to accept part of the blame for the continuing suffering of the victims.

After a few weeks of controversy the NTS therapy has now been accepted but mass detoxification is still being strongly opposed.

The trial with NTS is not the only study launched by the ICMR. It has sponsored many other studies on the Bhopal victims, but they lack an integrated approach. Thus lungs, eyes etc., are being examined independent of each other, by different investigators and the ICMR is unwittingly lending support to the first theory, namely, that MIC gas damages only tissues with which it comes into direct contact.

#### What exactly happened to the gas victims?

So many months after the disastrous gas leak, one still does not know what exactly has happened to those who inhaled the gases and are still surviving. This is not because all attempts to unravel the mystery have failed but because an integrated approach has not been taken to do so. Months after the disaster, thousands of the survivors are still suffering from debilitating symptoms which prevent them from going back to work.

The medical community and the officialdom have been adhoc in their efforts to render adequate succour to these hapless victims. A powerful medical lobby in Bhopal have opposed sodium thiosulfate, a treatment, with good potential



to the patients. They have no convincing argument for their stand. The IMA, (Indian Medical Association) the organisation which has authority over the medical profession, has remained totally mute. The doctors as well as the ICMR have concentrated entirely on those who were hospitalised and have not evolved a holistic, community approach to understanding the problem. The ICMR sponsored local studies with exception of the NTS trials have lacked the rigour and the epidemiological orientation that are necessary in arriving at a meaningful understanding of the problem.

*A point of utmost significance is that the victims of the Bhopal gas disaster mostly belong to the lowest strata of society and are not in a position to fight for their rights, be it medical aid or monetary compensation. It is, therefore, not very surprising that the government and its organisations have shown marginal interest in the after effects. It also reveals a lack of interest among our scientific community in investigating an environmental disaster of an unprecedented nature. On the other hand, one can observe the striking contrast with which all attempts were made to retrieve the Black Box of Kanishka, whose mid-air explosion resulted in the death of only 326 persons but needless to remind of the upper socio-economic class.*

## Recommendations

### Research

1. The research and follow up studies should shift focus from hospital/dispensary based studies of seriously ill patients to family/community based ambulatory patients.
2. Well designed clinical trials should be further initiated using sodium thiosulphate as a therapeutic and epidemiological tool to further establish the significant role it could play in mass therapy.

## Care, Surveillance and Rehabilitation

3. Psychosocial assessment and consequent counselling and rehabilitation are urgently required.
4. Mass treatment with sodium thiosulphate based on ICMR guidelines should be initiated maintaining good medical records.
- 5 A surveillance programme should be undertaken to assess risks to pregnant mothers, unborn babies and new born babies. There should also be close monitoring of the gynaecological problems of women.
6. It is necessary to have a long term surveillance of lung function in view of the postulated damage to lungs and resultant lung fibrosis. Similarly, eyes should be examined regularly.
- 7 A comprehensive listing of all gas disaster victims is a long overdue task necessary for mass treatment, compensation and rehabilitation. This must be done immediately.

## Communication

8. There is urgent need to evolve a continuing education strategy for all health personnel including doctors working in both government and non-governmental centres. These could be through newsletters, handouts and informal group meetings.

The areas identified are:

- (i) sodium thiosulphate therapy;
- (ii) identification and management of psycho-social stress;
- (iii) risks to mothers and unborn foetus and need for surveillance;
- (iv) family planning advice till completion of detoxification;
- (v) role of respiratory physiotherapy;
- (vi) management of lactation failure;
- (vii) caution against overdrugging;

- (viii) need for open minded surveillance of high risk groups;
- (ix) importance of medical records.

9. There is also urgent need for dynamic creative non-formal health education of the affected community through group meetings, posters and pamphlets with information and messages built around their life style, culture and existing socio-economic situation.

The areas identified are:

- (i) sodium thiosulphate therapy;
- (ii) ongoing research programmes and informed consent;
- (iii) risk to unborn and new born babies;
- (iv) family planning advice;
- (v) respiratory physiotherapy;
- (vi) management of lactation failure including low cost weaning foods;
- (vii) importance of records and regular check ups;

- 10 .. Occupational rehabilitation and compensation: In the ultimate analysis care of illness, health education, psychosocial counselling would be inadequate measures if they were not backed by adequate monetary compensation and urgent occupational rehabilitation of the disaster victims. This would have to be imaginatively done keeping their previous occupations and the residual disabilities in mind.

#### **Coordination**

11. The government machinery alone cannot handle such a massive task. The government must adopt a policy of enlisting the help of all non-governmental agencies and groups wishing to work in Bhopal. This enlistment must be active and supportive.

#### **and finally**

12. It is imperative that the victims as well as the entire country must be provided with all the details of how the accident occurred, of the nature of the chemicals released and of the reasons why the detoxification by sodium thiosulphate has been so badly mismanaged.

#### **medico friend circle**

The medico friend circle (mfc) is a circle of friends with medical/non-medical backgrounds who share the common conviction that the present system of health services and medical education is lopsided in the interest of the privileged few and must be changed to serve the interests of the large majority, the poor. mfc fosters a 'thought current': upholding human values, people and community orientation of health care and medical education, demystification of medical science and a commitment to the guidance of medical interventions by peoples' needs and not commercial interests.

mfc offers a forum for dialogue/debate, sharing of experience and experiments with the aim of realising the goals outlined above, and for taking up issues of common concern for action.

For further details regarding mfc BHOPAL STUDY contact--

Ashvin Patel  
 ARCH  
 21 Nirman Society  
 Alkapuri  
 Vadodara 390005

OR

Anil Patel  
 ARCH  
 Mangrol (At & P.O.)  
 Via Rajpipla  
 Dist Bharuch  
 Gujarat 393 150

(A detailed report of the study including background, objectives, materials and methods, observations and results, discussion, recommendations, important appendices including proformas and references and reading list is also available on request from the **mfc organizational office 326 V Main I Block Koramangala Bangalore 560034**

Price Rs. 8. 00)