Agreement between Morbidities Patterns Rendered By Questionnaire Based Survey and Verification by Medical Officer in a Cohort-Based Long Term Epidemiological Study

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ABSTRACT

Introduction: Questionnaire based surveys are an inexpensive way of collective information on morbidity patterns. This study aims to determine the agreement between morbidities recorded by the survey staff (TA) through questionnaire and that revealed via examination by medical officer.

Methodology: A long term follow up epidemiological study was launched in 1985 covering a cohort of 80021 gas exposed people and 15931 unexposed people. A list of 40 symptoms was provided for recording the morbidities The International Classification of Diseases was followed for coding the morbidity by Medical Officers. Data presented here were collected during January-December, 2016 and total 3393 multi morbid persons, ageing more than 32 years from cohort were taken. For finding the agreement of pattern morbidity between the technical assistant and the medical doctors, Kappa statistics was used.

Results: Overall Kappa 'moderate (0.41-0.60)' agreement was observed in respiratory morbidity. In ophthalmic morbidity 'Substantial (0.61-0.80)' was observed. We found overall (Respiratory, Ophthalmic, GIT and Skin) 'Moderate (0.41-0.60)' agreement.

Conclusions: Morbid agreement analysis established that substantial agreement between TA and medical doctor in affected areas where as in control area moderate agreement were observed. It is better to verify all symptomatic morbid persons by medical officer.

Key words: Bhopal Gas Disaster, agreement analysis, Any Morbidity, Respiratory, GIT, Gas Exposure

INTRODUCTION

Bhopal city of Madhya Pradesh, India suffered a major man made industrial disaster following toxic gas/s leak[1] from a Union Carbide factory on the night of 2nd /3rd December 1984. This gas disaster led to death of estimated 2,500 persons and 1,000 cattle within three days post disaster. Initial autopsies indicated cyanide poisoning evidence through "cherry red discoloration" of lung and toxic gases induced lung and other organ damage and later autopsies done up to one year post disaster revealed diffuse interstitial pulmonary fibrosis[2-5].

Man made toxic gas leak disasters though occur infrequently but result in big catastrophe, killing a large number of people and affecting larger number of morbid people. Many cohort based long term epidemiological studies were carried out using questionnaire based morbidity surveys to analyse the prevalence of morbidities. The advantages of these questionnaire based studies are that they could be completed easily by trained interviewers rather than by medical doctors who are more expensive and in short supply in developing country settings. However a critical limitation of questionnaire based study is the misclassification of the

symptoms into an disease of a particular organ system. Therefore it is important to understand the accuracy of questionnaire based cohort morbid or non-morbid and knowing whether it could provide a reasonable estimate of morbidity prevalence with in a community. We report here the comparative morbidities pattern accumulated/collected by questionnaire based survey followed verification by medical officer. Cost effective analysis could be done through agreement result. Our aim is to find out the level of agreement between morbidities recorded by the survey staff (TA) through questionnaire and verification made by the medical officer to validate morbidities collected data under cohort.

SUBJECTS AND METHOD:

Geography of exposed areas: At the time gas disaster (1984), Bhopal population was living in 56 wards 1984. On the basis of symptomatology revealed by Bhopal population following exposure, these 56 wards were further divided in to 36 Gas affected and 20 not affected wards (Table -1).

Study Design: A long term follow up of epidemiological study was launched in 1985 covering a cohort of 80021 gas exposed people and 15931 unexposed people[2]. One of the objectives of this study was to assess the temporal trend of the morbidities in gas exposed survivors in Bhopal and its relationship with the grades of exposure. A list of 40 symptoms was provided to TA for recording the morbidity [6] in questionnaire. The International Classification of Diseases was followed for coding the morbidity by medical officers. The medical officers have to check 25% the work carried out by TA's in their respective areas. The families with morbidity were visited by medical officer to verify the data being recorded by the TA for accuracy. Medical officers finalised the diagnosis based on examinations and available documents related to current treatment. The generated information was being submitted to statistical/computer unit for scrutiny and data analysis.

Data Collection: The study was initiated in the year 1985 and six monthly follow up of the cohort population is being continued. Here the data collected during 52nd six monthly survey (Jan - June' 2016) and 53rd six monthly survey (July-Dec 2016) have been considered for analysis. 52nd survey is considered as 1st six monthly and 53rd six monthly have been considered as 2nd six monthly survey. During the 1st six monthly survey (Jan - June' 2016) a cohort of 23,981 people from severely affected (n=8,141), moderately affected (n=8,535) and mildly affected (n=7,305) areas and 6,427 individuals from control areas was followed up, similarly in 53rd round (July-Dec 2016) of survey (n=8059) from severely, moderately area (8490), mildly area (n=7370) and control area (n=6567) were followed up.

Statistical analysis used: For finding the agreement of pattern morbidity between the technical assistant and the medical doctors, Kappa statistics was used with help of SPSS Software.

RESULTS

For the analysis purpose ,we have combined both 1st and 2nd survey data for common cases 1083 morbid individuals from severely exposed ,moderately exposed(851),mildly exposed (669)areas and 790 individuals from control area who were attended by both medical officers and TA. So total 3393 multi morbid persons, age more than 32 years from cohort were taken up for agreement analysis. Almost 100% cases found morbid as cases referred by TA to medical doctors, in terms to any morbidity. The purpose of data analysis all the symptoms were regrouped in reference to various systems like Respiratory, ophthalmic, Gastrointestinal Tract and Skin.

Agreement between morbidities (Kappa statistics)

Respiratory Morbidity:

Definition of having Respiratory morbidity coded by research assistance was based on symptoms like Dyspnoea, Cough, Expectoration, Wheezing, Chest pain and Haemoptysis. Provisional diagnoses are being recorded by medical doctors as per ICD.

For finding the agreement between the technical assistant and the medical doctors in coding the respiratory morbidities, Kappa statistics was applied. According to Kappa statistics, if k < 0, no agreement and 0-0.20 as slight, 0.21-0.40 as fair, 0.41 –0.60 as moderate, 0.61-0.8.0 as substantial and 0.81−1 as perfect agreement are recorded. We found that, in year 2016, overall 'moderate' agreement (0.41-0.60) was observed in respiratory morbidity (Table-2). In specific to the exposure areas, 'fair' agreement (0.21-0.40) was observed in moderate and mild areas and 'moderate' agreement (0.41-0.60) was observed in severe and control areas. There is marked difference between TA observations versus Medical Officers observation.

Ophthalmological, GIT and Skin Morbidity:

Definition of having Ophthalmological morbidity coded by research assistance was those who have symptom codes either having eye irritation, lacrimation, burning, photophobia and defective/dim vision. Medical doctors used ICD coding to represent the ophthalmological symptoms.

Table -1: Distribution of Population of Bhopal – Selection of Cohort Population

Areas Affected/ Exposed	Severely	Moderately	Mildly	Total	Areas Unaffected /Control	Grand Total
Municipal Wards As per Bhopal Nagar Nigam	2*	5@	29#	36**	20@@	
No. of Municipal Wards Selected	2*	5@	4$	11	03##	56
Estimated Population for 1984 based on 1981 census	32476	71917	64293	168686	311642 (37.42%)	832904
Deaths (Dec. 3-6,1984) Reported by Bhopal Nagar Nigam	714	96	19	829	2	
Death Rates during 3-6 Dec. 1984(Per Thousand)	21.98	1.33	0.29	5		
Estimated Population for 1985 Based on 1981 census	34879	77239	447717	559835	334703	894538
Cohort Population during Aug.- Oct. 1985	26382	34964	18675	80021	15931	95952
% of Population covered from 1985 estimated population	76.64	45.27	4.17	14.29	4.76	10.73

Ward numbers: *(13,20); @8,11,14,45,46; #7,9,12,44,11,5,6,10,15,16,17,18,19,21,22,23,24,25,26,27,28,29,8,39,40,41,42,43,47; $ (7,9,12,44);
** Population 521262 1981 Census; @@2,3,4,30,31,32,33,34,35,36,37,48,49,50,51,52,53,54,55,56; ##36,54,55

Table 2: Respiratory Morbidity

Area	Technical Assistant		Respiratory Morbidity by Medical Doctor			Agreement
			Yes (%)	No (%)	Total	
Severe	Respiratory Morbidity	Yes	243 (45.7)	288(54.3)	531	**0.45(p<0.001)**
		No	8 (1.4)	544 (98.6)	552	
		Total	251	832	1083	
Moderate	Respiratory Morbidity	Yes	71 (27.6)	186 (72.4)	257	**0.34(p<0.001)**
		No	5 (0.8)	589 (99.2)	594	
		Total	76	775	851	
Mild	Respiratory Morbidity	Yes	81 (28.4)	204 (71.6)	285	**0.31(p<0.001)**
		No	1 (0.3)	383 (99.7)	384	
		Total	82	587	669	
Affected	Respiratory Morbidity	**Yes**	395 (36.1)	678 (63.9)	1073	0.40 (p<0.001)
		No	14 (0.9)	1516 (99.1)	1530	
		Total	409	2194	2603	
Control	Respiratory Morbidity	Yes	65 (43.9)	83 (56.1)	148	**0.48(p<0.001)**
		No	22 (3.4)	620 (96.6)	642	
		Total	87	703	790	

Table 3: Ophthalmological, GIT, skin and overall Morbidity agreement

Morbidity by Technical Assistant	Morbidity by Medical Doctor							
	Affected Area				Control Area			
	Yes (%)	No (%)	Total	Agreement	Yes (%)	No (%)	Total	Agreement
Ophthalmic								
Yes	1232 (84.5)	225 (15.5)	1457	0.80 (p<0.001)	71 (64.5)	39 (35.5)	110	0.72 (p<0.001)
No	45 (3.9)	1101 (96.1)	1146		8 (1.2)	672 (98.8)	680	
Total	1277	1326	2603		79	711	790	
GIT								
Yes	114 (38.6)	181 (61.4)	295	0.31 (p<0.001)	23 (41.8)	32(58.2)	55	0.45 (p<0.001)
No	186 (8.1)	2122 (91.9)	2308		17(23)	718 (97.7)	735	
Total	300	2303	2603		40	750	790	
Skin								
Yes	14 (21.2)	52 (78.8)	66	0.33 (p<0.001)	15 (36.5)	26 (63.5)	41	0.51 (p<0.001)
No	4 (0.2)	2533 (99.8)	2537		1 (0.2)	654 (99.8)	655	
Total	18	2585	2603		16	680	696	
Overall								
Yes	1679 (78.6)	392 (21.4)	2071	0.62 (p<0.001)	177 (58.2)	127 (41.8)	304	0.55 (p<0.001)
No	21 (3.9)	511 (96.1)	532		31 (6.4)	455 (93.6)	486	
Total	1700	903	2603		208	582	790	

Definition of having GIT morbidity coded by research assistance was those who have symptom codes either having lack of appetite, abdominal pain, constipation, diarrhea, vomiting, gastritis and haematemesis. Medical doctors used respective ICD coding to represent the GIT symptoms. Definition of having skin morbidity coded by research assistance was those who have symptom code for skin and allergy problems. Medical doctors used respective ICD coding to represent the skin morbidities.

In ophthalmic morbidity, "substantial" agreement (0.61-0.80) was observed between TA and medical officer in both the affected and control areas in the year 2016 (Table-3). In GIT morbidity, "fair"

agreement (0.21-0.40) was found in affected area and "moderate" agreement (0.41-0.60) in control area. Similarly, in skin morbidity "fair" agreement (0.21-0.40) was observed in affected area and "moderate" agreement (0.41-0.60) in control area. In ophthalmic morbidity there was hardly any difference between TA and Doctor's observation.

Overall (Respiratory, Ophthalmic, GIT and Skin) morbidity agreement

For finding the overall agreement between the Technical Assistant and the Medical Doctors including the respiratory, ophthalmic, GIT and Skin morbidities, Kappa statistics was used. It was found that, overall 'moderate' agreement (0.41-0.60) was observed, in specific to the exposure areas, 'substantial' agreement (0.61-0.80) was observed and 'moderate' agreement (0.41-0.60) was observed in the control areas (Table-3).

DISCUSSION

This epidemiological study no doubt is one of the longest running study in India, as it has completed its 32 years of operation till December 2016. Study of this magnitude for such a long time had its own challenges, like holding cohort, operating on the same methodology etc. The study did produce a gold mine of data. Questionnaire based surveys are an inexpensive way of collective information on morbidity patterns. However, given the limitation of questionnaire based studies such as misclassification of morbidity and false positive, false negative data, such surveys need to be validated through examination by Medical Doctors. This study aimed to determined the agreement between morbidities recorded by the survey staff (TA) through questionnaire and that revealed via examination by medical officer.

Morbidity studies[7] showed that there has been multisystem involvement due to the exposure to the toxic gas. The information collected based on 40 systems covering different systems showed that there has been persistently high any morbidity along with high lung, ophthalmic and GIT morbidities in affected areas especially in severely affected area. These symptomatic morbidities were also verified by medical officers. The diagnosis made by these medical officers was based on symptoms as well as possible signs as elicited during the examination of individual patients in the families. This study showed that majority of the morbid people had diseases of longer durations. These observations are tested using symptomatic and clinical diagnostic criteria for morbidities under point prevalence analysis. The result of our analysis indicates that the agreement of TA and medical of-

ficer is dependent on the type of symptoms and diseases.

Respiratory morbidities too have followed decreasing pattern as compare to medical doctors with TA. Any morbidity rate between TA and medical doctors are same but in case of specific morbidity like respiratory morbidity agreement differs as TA records 5 symptoms namely Dyspnoea, Cough, Expectoration, Wheezing, Chest pain and Haemoptysis which can contribute for other diseases apart from respiratory. So when examined by Doctors the disease pattern was different. Dyspnoea symptom code could be related to breathlessness because of respiratory disease, cardiac disease, general debilities and anaemia[8]. So difference was observed between TA and Doctors in respiratory disease. This symptom was included in respiratory morbidity for analysis purpose when data related to TA was considered for analysis. In case of ophthalmic morbidity both agreed due to narrow span of ophthalmic morbidity reported by TA and Doctors as it is self explanatory. Very good agreement was found for ophthalmic cases. Many other studies also showed very good or good agreement for this illness[9].

Hence, the bias in the use of histories for community assessment of morbidity appears to be symptom specific. In spite of the problems concerning whether the clinical examination really can validate the TA (Questionnaire) based, accuracy of such histories in gas affected Bhopal city[10] . The accuracy of TA questionnaire varies substantially from one morbidity to another. This has implications for the use of these questionnaires in estimating morbidity prevalence and in estimating the impact of treatment on different morbidities[11] .This study is facing large problem due to compensation which causes self perceived morbidity. This study established that by using proper design of study and covering cohort population in every six months through TA and morbid persons verified by medical doctors is one of the best cost effective methods and also establish causes and effects relation in case of toxic gases disasters. Morbidity agreement analysis established that substantial agreement between TA and medical doctor in affected areas where as in control area moderate agreement were observed. Morbid person may be clinically examined by medical officer at field level and further chronic ill patients may be sent to concerning Hospitals. It is better to verify all symptomatic morbid persons by medical officer with major focus on clinical disease identification and treatment. This cohort is considered adequate for useful analysis as well as for projection of its results on total population , keeping in view of TA and Medical doctors morbidity agreement. Poor agreements are not due to poor validation of ques-

tionnaire because questionnaires are passes through different phase of scrutiny. Due to compensation to gas victims and self perceived morbidity, there may be over reporting of symptoms in exposed population. This is one of the few analyses of agreement which was performed with large number of chronic conditions, most studies considered fewer diseases. Furthermore, this study compared medical Doctors report in personal interview, where many other studies simply took medical records as a source for the physician's statement[12-17] .Few studies involved Doctor's in their analysis of concordance[18].We assume that personal interviews have a better validity than an analysis of medical records.

When system wise morbidity was analyzed , there had some discrepancies noted between TA and Medical Officer. Extensive follow-up with major focus on clinical disease identification and treatment may be taken–up. This cohort base study for toxic gas disaster in which many factors are involved and need to be continued for a long run ,this methodology is one of the best cost benefits methodology. 100% of morbidity of TA may be verified by medical officer for good agreement. Duration of survey should be one year time period for cost effectiveness, better management of gas victims and getting high quality data. Further research is needed to identify more reasons for disagreement and their consequences in health care.

Outcome – Primary and Secondary end point

Overall Kappa 'moderate (0.41-0.60)' agreement was observed in respiratory morbidity. In ophthalmic morbidity 'Substantial(0.61-0.80)' was observed. We found overall (Respiratory, Ophthalmic ,GIT and Skin) 'Moderate(0.41-0.60)' agreement. Almost 100% cases found morbid as cases referred by TA to medical doctors, in relation to any morbidity. In specific to the affected areas substantial agreement (0.61-0.80) was observed. This is an alternate methods for data validation is now available in symptomatic questionnaire based survey .

LIMITATION

It is known facts when issues of compensation were being discussed there might be some persons intentionally providing some false information regarding health status. A proper check on sample bias was in – built to be carried out by Medical Officer to minimize such false information. Although intensive training was given and quality control aspect was in built still, some bias might have crept in data collection which may be beyond control in such a large survey.

Future research directions: It is better to verify symptomatic morbid persons by medical officer with major focus on clinical disease identification and treatment. Since this study is only cohort study which has been carried out on gas affected people in last three decades and there is no other health door step monitoring system with inbuilt research component in practice as on date. Hence it is suggested that newer studies on remaining population of original total gas exposed population 5,74,000 could be undertaken and extensive follow up with major focus on clinical disease identification and treatment . The studies may be planned with in such a manner so that they can impart guidelines and direction for health service sector .

Ethical Clearance: Secondary data have been used in this article. Study was initiated in the year 1985. Ethical clearance had been taken at that time.

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