Epidemiological applications: a case report of a village epidemic of gastroenteritis

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Abstract

This is a case report of an epidemic of gastroenteritis which was investigated and controlled by epidemiological methods only, before laboratory investigations could be done to confirm the original epidemiological conclusions - from contaminated home made ice-cubes. The case and process are reported in order to encourage similar uses of epidemiology by field public health practitioners, especially within the district or primary health care systems and particularly in places where laboratory support are difficult to avail. The case is used also to discuss the equipments and facilities that ought to be part of the support system for every modern field public health practitioner. These should include computers, modern communication facilities and epidemiological support systems, especially senior epidemiologists, as such senior personnel are available to junior colleagues in the other areas of specialist medical practice.

Introduction

Epidemiology has developed greatly within the last quarter century. This development has involved both the old time population-based (public health) epidemiology as well as the newer applications such as in clinical epidemiology[1], etc. Today, within specialist laboratory and clinical medicine, we now talk of such things as molecular epidemiology, neuro-epidemiology, sero-epidemiology, pharmaco-epidemiology, etc. Very rapid and extensive applications of epidemiology are going on in all these areas worldwide currently. In spite of these, both at the undergraduate and post-graduate training in the discipline for would-be practitioners in public health, the subject has usually continued to be rather abstract to the students. Some of the factors responsible for this include the fact that teaching examples are usually not of cases seen and managed within the day to day practice of public health or from the district health systems where this applies most. The teaching cases are often obtained from obvious theoretical formulations or the occasional case handled by some research or other ivory tower institutions.

Residency programmes in public health medicine leading to membership and fellowship qualifications as in the other medical disciplines usually have enough duration and field practice to enable their qualified public health physicians to be able to function without the need for such extra support.

Doctors who train in public health at only the DPH/MPH level who go out to practice as field community physicians (within the district or actual primary health care systems) often are not able to apply the full extent of possible day-to-day epidemiology. This is usually because they lack enough experience of day to day application of epidemiology in the usually short, intensive academic but less field practice-based training. Furthermore, they would usually have no immediate experienced public health specialist support as equivalent specialists in the (more) clinical disciplines usually have; in addition to the longer (residency) training programmes. Residency programmes in public health medicine leading to membership and fellowship qualifications as in the other medical disciplines usually have enough duration and field practice to enable their qualified public health physicians to be able to function without the need for such extra support. However the DPH/MPH programmes dominate any residency programmes in these post-graduate training programmes in community or public health medicine. Moreover, these intermediately trained field practice public health physicians usually do not get their necessary computing facilities to assist them in the job in many places as yet.

With the present development trend in public health practice in Fiji, it is hoped to be able to provide computing

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Table 1. Summary of the epidemic of NGT village

Population factor	Value
Population of village	255
Males	133
Females	122
Age range	8 months - 80 years
Population affected by epidemic	59
No presenting at the health centre	14
Number admitted in hospitals	8
No who drank ice cubes*	133

** Some subjects drank from multiple sources*

facilities to every district health system (the Sub-divisional health services). With such a facility in one of the Sub-divisions, it was possible to exercise the epidemiological function reported here. We use the report to discuss the application of field epidemiology as well as some practical issues for the improvement of epidemiological practices within the modern district health systems and the wider public health and primary health care services. Most DPH/MPH level public health physicians will end up practicing at this level of the health services, at least initially.

Case report

At about 4.30am one Saturday morning, a young girl presented at one of our health centres from NGT village with a history of bloody diorrhoea and vomiting. By 10.30am, 13 other children and youths had presented from the village with various ranges of gastroenteritis, from moderate to severe. The district hospital, with only 4 empty beds left, admitted 4 of the less severe cases while the most severe 4 were referred to the reference hospital. The other 6 milder ones were rehydrated or howsoever else treated at the health centre and later sent home. Personal histories of the patients could not give a clue as to the cause of the epidemic as all the patients denied taking part in any common eating and they all came from different families. A visit was made to the village by mid-day that same day to investigate the epidemic.

At the village, it was learnt that many more affected people had milder attacks. There had been no feasting in the village in the last few days or any other known public eating at which the villagers took part in. The water supply in the village came from a dam on a nearby hill, from which another close-by (NKN) village also got its own, similarly untreated, water. A common pipe is used by both villages to source their water from the dam. However, there was lower water pressure experienced at the further placed NGT (the epidemic) village after a recent non-village settler connected into the pipe. The pressure could no longer carry the water up to the originally provided sand filter at NGT village; and so, the water was directed straight to the village without passing through the filter in the last 6 months. NKN still had its own water filtered through their own (similarly previously provided) sand filter. The villagers also had not cleaned up the dam in the last 4 months as they used to do earlier. A heavy rainstorm in the previous 10 days had broken branches and leaves of a mahogany tree into the dam and these were beginning to rot in the water. However, the villagers had not noticed any change in the taste of the water or of its colour, which continued to look in every way potable. Nobody in NKN village had developed gastroenteritis since the last 10 days and none in NGT village either, until the present epidemic. Apart from the possibly contaminated water, probably added to by any faecal wash-ins from the floods of the rainstorm, factors thought to possibly contribute to the epidemic were as follows:

Table 2. Distribution of ice-cube patronage and gastro-enteritis outcomes among the village population

		No. who developed symptoms		
Ice-cube source	No. of patronage	Diorrhoea	Vomiting	Hospital Admission
Jama	1	0	0	0
Jose	43	16	9	2
Fili	61	18	10	4
Roko	24	8	3	1
Ako	19	7	5	1
Lora	7	0	0	0
Tale	6	0	0	0

** All took ice cubes from Jose, Fili or Ako also.*

Table 3. Statistical association between the risk factors of the epidemic and some of the disease outcomes

		X^2 value	P-value
a.	**Association with diorrhoea**		
	Ingestion of ice cubes	13.0	0.0003
	Age group (<20 yrs old)	9.3	0.002
	Ingestion of Jose's ice cubes	6.3	0.01
b.	**Association with vomiting**		
	Ingestion of ice cubes	16.8	0.00004
	Age group (<20 yrs old)	12.4	0.0004
	Ingestion of Jose's ice cubes	11.3	0.0008
	Ingestion of Ako's ice cubes	7.8	0.005
	Ingestion of Fili's ice cubes	7.6	0.006
c.	**Association with hospital admission**		
	Ingestion of ice cubes	4.8	0.03
	Age group (<20 yrs old)	3.7	0.05

- Swimming, and so possibly drinking, in the river that is not very clean and which flows by NGT village but not the further away NKN village. It had been very hot in the previous few days, suspectedly possibly necessitating more frequent swimming than before.
- Drinking home-made commercial sweetened ice-cubes, which were made and sold by 7 different traders in the village - namely by Fili, Ako, Roko, Tale, Lora, Jama and Jose.

Both adults and children were affected by the milder forms of the epidemic within the village. All those affected were given oral rehydration solution and the village health worker had more sachets left to promptly prepare and give to anybody else who develops diorrhoea or vomiting later. On the whole, 59 of the 255 NGT villagers were affected by the epidemic, including the 14 that presented at the health centre. Information was collected on everybody in the village by the community nurse in charge of the area, on the following, for the previous 24-48 hours: serial number, household name; own name; drank the village tap water?, drank commercial sweetened ice cubes?; swam in the local dirty water?; ate food from outside home?; attended feast somewhere?; ate any unusual food?, age, sex; had diorrhoea?; had vomiting?; was admitted in hospital for gastro-enteritis?; drank ice-cube from any of Jama?, Jose?, Fili?, Roko?, Ako?, Lora? or Tale?.

Meanwhile all drinking water in the village was ordered to be boiled before such drinking. The sweetened ice-cube makers were ordered to stop preparing any new ones except with freshly purchased ingredients and boiled water. Arrangement was also made for the Public Works Department to supply the village with tankers of treated water for drinking over the weekend. As it was Saturday and the public health laboratory unit could not be contacted, the village tap water or ice-cubes could not be tested for faecal coliforms until Monday. On Monday, the epidemiological data was computerized and analyzed using the Epinfo 6 software.

Tables 1 and 2 give the summary of the epidemic and the NGT village in that regard. Table 3 shows the results of the tests of association between the 3 different outcomes of the epidemic collected in the epidemiological data and all the risk factors collected, for the significant associations only. The Fisher's Exact test instead of the X^2 test was used in cases involving small numbers (e.g., with Lora, Tale and Jama), but none of those yielded significant associations. The ingestion of home made commercial ice-cubes consistently showed significant association with all the disease outcomes, as well as age (less than 20 years; i.e., young people). Of the individual ice-cube outlets, Jose's showed the highest and most consistent association, followed by Ako's and then, Fili's - Table 3. Everyone who had vomiting had taken ice-cubes, singly or including those from either of Jose, Ako or Fili; but not from any of the other 5 ice-cube traders, alone or in their exclusive combination. The three traders were therefore informed accordingly and encouraged to follow strictly on the instructions given to all of them on Saturday, as any other epidemic from them will not be condoned whatsoever. The villagers were also encouraged to clean their dam now, and not wait for another epidemic before doing so.

Laboratory tests on the village tap water in both NGT and NKN villages were started on Monday, as well as on the ice-cube samples from the traders in NGT. The results were available a week later and showed the tap water in both villages to be equally contaminated by both vegetative and fecal (E. coli) coliforms, but not by Shigella or Salmonella spp. The ice-cubes showed both vegetative and faecal coliforms, several multiples of the tap water level. Some of the ice-cubes yielded Staphylococcus aureus, notably the one from Jose. The stools of 2 of the 4 children hospitalized at the referral hospital (that were the only ones thus tested)

yielded Shigella flexneri type 3. The hospital laboratory report on the stool samples did not say anything about E. coli or Staphylococcus aureus - the pathogens isolated in the village tap waters and ice-cubes. They were not specifically asked for in the request but only for tests for gastro-enteritis.

Discussion

The epidemic of gastro-enteritis in the village discussed here had many false clues initially. These included the recent non-filtration of the water going to the epidemic-affected (NGT) village and the recent rainstorm and flooding into the dam possibly washing some contamination into the water. There was also the issue of possible chemical contamination from the mahogany plant materials that fell into the dam. The fact of the time lag between any of the events and the epidemic and that the near-by village that shares the same water source was not affected, no matter how slightly, made those possibilities less likely. However, the epidemiological analysis of the risk factors soon gave the ice-cubes as the only statistically (and epidemiologically) significant factors in the causation. This enabled us to have conviction on the initial decision on the ice-cubes preparation taken on the mere situational assessment, and in fact, to sharpen its focus on the three culprits. The fact that the adults were not severely affected by the epidemic suggests that the disease agents may have been common in the village with the adults having developed relative immunity to the agents. The results of the water tests later strengthened this notion - the entire village water carrying faecal coliforms and not only the immediate epidemic-causing ice cubes.

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A set of contaminated ingredients used in preparing the ice-cubes may have caused the epidemic as none has occurred since then. However, this is also entirely explainable as due to the success of the control measures taken on the epidemics. The fact that none of the village specimens yielded Shigella while that of 2 of the tested 4 affected children did, suggests again that Shigella may be carried by the subjects and only multiplied as the persons got ill with the E. coli and Staphylococcus from this epidemic.

It is not always possible in many district health systems in the developing countries to be able to test water sources for potability within the time frame to help with the control of epidemics. The situation in the district where this epidemic occurred is definitely better than would be the case in many developing countries. However, with the availability of computer facilities, it will be easy to investigate and analyze the epidemiological information as done here and for a confident control to be implemented. It has been observed that as the stethoscope is to the medical doctor and the syringe and needle is to the nurse, so is the rate[2] and the instruments of measuring it to the epidemiologist. "The rate" is the fundamental tool of epidemiology.

In today's world, the computer is our working tool to put data together, analyze them and get our rates. The computer should therefore be considered as essential to the work of a medical officer of health (the sub-divisional medical officer in Fiji) as a stethoscope is to any full time clinician colleague. We also believe that more field experience of the day to day uses of epidemiology in community health work should be reported in the medical literature as clinical experiences are reported for the full time clinicians. These should not be only for detailed epidemiological research (as happens now only) but even as short communications and case reports as presented here. In that way, the application of epidemiology in all it's ramifications will more easily be understood as a matter of routine for all who practice public health, even for people with no such post-graduate training there as yet, within the district and primary health care systems.

As many district medical officers (of health) usually work far away from experienced public health physicians as epidemiologists, communication facilities - telephones, faxes, e-mails - should be provided for them as much as possible. With those, they can keep in close touch with epidemiologists at the higher levels of the health services for needed help. This should include academic public health physicians (epidemiologists) in the medical schools also. This will seem to be the only way that their relative isolation will be overcome, as district health systems will always be too small to have many such practitioners within it, senior and junior. An epidemics investigation and control unit in the Ministry of Health to make rapid response to epidemics (as well as major occupational accidents) in the country will also be advisable; and will serve the type of need identified here in the future.

The report here shows some limitations of actual field practice of public health, which is very healthy to always be aware of and which are usually not seen or reported of in ivory-tower epidemiology. For example, because the environmental health unit of the sub-divisional health service was responsible for collecting and testing the water and ice cubes from the village, these were not collected according to the water taps and ice cube sources followed by the clinical public health team. The results were therefore not reported as such. So, ice cube contaminations were not accounted for from all the traders (nor identified individually in the specimens sent to the lab). Tap water was also not collected and identified from each of the ice cube trader households. In deed, only Jose's household tap water and

ice cube result were specifically identified, and that was simply by chance. However, the overall results were still usable for the epidemiological intelligence needed for the control exercise. If another epidemic like this were to occur here, the clinical team will have to leave clear instructions to the laboratory team as to the specimens to be collected and not leave it to their non-clinical initiative. Also, because commercial sweetened ice cubes as sources of epidemic gastroenteritis has not been known to occur like this, requests and routine laboratory investigations at the reference hospital had sought for Shigella and Salmonella only. It did not say what other pathogens were sought and not found. In another epidemic like this, it will be important to ask for microscopy and culture specifically to include all other pathogens like E. coli and Staphylococcus as experienced here. In that way, fuller and better correlation of every aspect of the epidemics can be done. It is hoped that those who are informed about this experience will also be able to exercise such better epidemiology as possible if an epidemic like this occurs in their district - part of the purpose of this paper.

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The aim of medicine is to prevent disease and prolong life, the ideal of medicine is to eliminate the need of a physician.

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