

Water services and public health: the 2000-01 cholera outbreak in KwaZulu-Natal, South Africa

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8th World Congress on Environmental Health 22-27 February 2004
Durban, South Africa

ABSTRACT

Cholera is a disease largely of absence of sanitation and is closely associated with deep impoverishment and deprivation. It can be eradicated by fairly elementary public health measures such as provision of sanitation, clean drinking water and encouragement of hand washing. Reports of outbreaks to the WHO show that cholera, which was previously widespread in the former colonial regions generally is increasingly limited to the African continent. South Africa is one of the most developed states in Africa and the incidence of cholera was something of a surprise. In the post-apartheid period has given priority to the delivery of water and sanitation to rural areas, was subject to a substantial outbreak of cholera in the period 2000-2001. An outbreak in August 2000 in KwaZulu-Natal Province, gave rise to more than 100 000 cases by 8 August 2001. According to WHO statistics this was the biggest outbreak in Africa for that period, all in all, the South African outbreak accounted for 80 percent of all cases worldwide in the reporting period. It was both significant internationally and in terms of its policy implications.

In the post liberation period cholera is associated with colonial experiences and impoverished countries and not with a government which is well attuned to the needs of the rural people.

In 13 months period of the cholera outbreak, there were 114 000 cases reported which resulted in 260 deaths in the nine provinces although the vast majority were in the province in which it originated. There was, by various comparative standards, a fairly low level of mortality (at 0.31% of those infected), but a high incidence.

While the epidemic raged largely in the rural areas, its epicentre was in the outskirts of the industrial region expanding most rapidly in KwaZulu-Natal; the Empangeni-Richards Bay industrial complex. The first case was confirmed in the informal settlement (or to use the MDG term 'slum') of Madlebe on the 14th August 2000; significantly this was not in a rural context. Although in popular imagination epidemics are associated with neighbouring countries there is no clear linkage incidences in neighbouring countries (like Mozambique) or to travel in the initial phase and it appears to be shown to be endemic.

The question arises why South Africa which has a high profile policy of water services delivery should suffer such a prolonged and widespread epidemic. The outbreak of cholera appeared to indicate a considerable gap between the promise of basic municipal service delivery and the reality of unsanitary social environments mostly in rural, but possibly more acutely in peri-urban areas and slums. It is evident that the disease is closely associated with deep levels of poverty where people are vulnerable to lack of publicly provided sanitation. In the inception of the epidemic debate focused on impediments to public access to clean drinking water through rigorous cost recovery measures in the Madlebe area. As the epidemic advanced the relationship between poverty, backlogs in water and sanitation provision and health conditions was very actively debated. Was cholera the result of a low level of service delivery or precipitated by the emphasis on cost recovery and payment for water services?

The second question relates to the extent and persistence of the epidemic which pointed to problems with the public health messages and interventions led by the Department of Health and supported by other departments, the military, and local agencies. Questions have been asked about the effect of the messages being communicated. To what extent were the messages put over in print, radio and television effectively communicated and having the result envisaged? It is not clear whether the health messages and campaigns have had the desired result. During and following the epidemic there was a particular focus on 'anti-cholera' strategies in accelerated water and sanitation delivery and were these measures sustained?

There were significant tensions and meetings at ministerial level to coordinate the responses and for the first time the Disaster Management Act was employed to provide managements structures to deal with the crisis. Two questions arise from these phenomena: why were the public health messages relatively ineffective in stemming the tide of the epidemic and what were the problems encountered in securing effective departmental coordination. The effectiveness of messages on sanitation and handwashing is assessed in the schools which as the one state controlled and directed institution in the rural areas should operate as models of hygienic practice. It was found there were poor standards of sanitation and no facilities for hand washing. There were no posters relating to the cholera epidemic or hygiene practice in the classrooms and it was unclear the extent to which hygiene and water and sanitation featured in the curriculum. In short the schools practice showed that the departments of education, health and water affairs were ineffective in getting messages to the youth and ensuring they were reinforced.

The public health intervention was founded and managed on the basis of an emergency strategy which, for the first time in South African history, employed the Disaster Management Act of 2002 for a health problem. Emergency strategy led to concentrated focus on anti-cholera coordinated activities and succeeded finally in bringing the epidemic under control (although not its elimination). It did, however, raise issues in relation to its relationship to the longer term social question of service delivery and accountable government.

The intervention has been assessed as both effective but also expensive. The question has been what lessons have been learnt and what basis has been laid for dealing with the public provision of water services to maintain public health. The questions of institutional accountability and responsibility in the control of cholera outbreak and in the long-term response also arose.

Questions were raised about whether there was a link between this epidemic and the HIV/AIDS pandemic and the impoverishment of the South African rural communities.

In this paper the cholera epidemic is described and assessed in terms of the vulnerability of the rural communities in South Africa to water borne diseases, the gaps which were evidenced, and the in terms of the various forms of intervention, the messages put over, and the long term lessons drawn from its incidence.

The broad question is why South Africa, which is conducting a program of accelerated community water and environmental sanitation delivery should experience such a setback forcing diversion of resources from water delivery and from AIDS intervention to elementary public health issues.

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To the surprise of many South Africa suffered one of the most dramatic outbreaks of cholera on its east coast in the late months of 2000. This was a surprise as it was generally not anticipated by the public health services or the political leadership as South Africa is certainly the most advanced country in Africa in terms of its economic development and levels of service. In addition a 'liberation' government has come to power with the promise of meeting basic needs and alleviating poverty among the black majority who suffered so grievously under the apartheid government.

Cholera is a disease largely of absence of sanitation and is closely associated with deep impoverishment and poor service delivery. The bacteria is spread mainly by contaminated water and food, attaches to intestinal wall, multiplying to produce a poisonous chemical which prevents the body processing water. Up to 14 litres of diarrhoea can be passed in one day and it can lead to death in 24 hours. The disease has caused terror to populations and in the 19th century has devastated first world cities where it has been described as ending in *mort de chien*, a dog's death, in agonising cramps, diarrhoea, and exhausted death. It can be eradicated by fairly elementary public health measures such as provision of sanitation, clean drinking water and encouragement of hand washing. Reports of outbreaks to the WHO show that cholera, which was previously widespread in the former colonial regions generally is increasingly limited to the African continent. South Africa is one of the most developed states in Africa and the incidence of cholera was something of a surprise. In the post-apartheid period has given priority to the delivery of water and sanitation to rural areas, was subject to a substantial outbreak of cholera in the period 2000-2001. An outbreak in August 2000 in KwaZulu-Natal Province gave rise to more than 100 000 cases a year later and there were continuing outbreaks in this and other provinces. According to WHO statistics this was the biggest outbreak in Africa for that period, all in all, the South African outbreak accounted for 80 percent of all cases worldwide in the reporting period (IRIN, 2002?). It was both significant continentally, internationally and in terms of its policy implications locally.

There are three broad themes in the paper: firstly the identification of gaps between policy and practice in public health provision and basic human needs; secondly disaster strategies of inter-departmental cooperation and coordination, the thirdly the effectiveness of messages in bringing about behaviour change.

This paper will concentrate on the gaps identified through the incidence of cholera and during the epidemic itself. These appear in terms of provision of basic services and maintaining public health with the backlog in water services most acute in the peri-urban areas and deep rural areas which was evident prior to the cholera outbreak in high levels of diarrhoeal incidence. This is the context of rural traditional life and lags in delivery of water services could explain the extent and persistence of the epidemic. This gap was closed for the most acute period of the epidemic through the provision of alternative supplies of clean drinking water and some means to purify water.

The second gap which is identified is that between the messages on cholera control and limitation of the epidemic, and their communication, reception and effect. Early on in the epidemic there were comprehensive messages prepared by the agencies involved in the anti-cholera intervention and their communication to rural communities was possible through radio, television, and pamphlets. There was also direct person-to-person communication possible through the network of Community Health Workers (CHW) established throughout the province. Yet the persistence and spread of the epidemic indicates that the messages appeared to have little effect until fairly well into the epidemic and even then this is not certain.

South African rural areas are not alone in having problems in improving public health through health and hygiene promotion. In a review of infectious disease world-wide, Curtis (2003) records that diarrhoeal diseases alone causes the death of at least 2 million children a year and yet there is evidence that few people at critical moments act on the basis of hygienic principles.

To understand the context of the epidemic the basic health and sanitary conditions of South African rural areas and peri-urban areas will be described and the health system operating in rural areas explained. The hygiene education and sanitary practice of the schools of KwaZulu-Natal will be examined as a case study in terms of the application of health education and promotion.

Health facilities and education in rural KwaZulu-Natal

Deep poverty and deprivation are largely concentrated in the rural communities of South Africa. Apart from some hospital which maintained a reputation for excellence during the early apartheid era there was generally a decline in the quality of health services in the previous period despite their expansion. The rich tradition of social medicine explored and developed in KwaZulu-Natal was destroyed by the apartheid regime and the advocates of social medicine in which South Africa took a lead, “a practice of medicine concerned with health and disease as a function of group living” and the health of “the whole community as a community” (Kark and Steuart, 1962:3) were dispersed to other countries. The attack on dedicated medical practitioners in rural communities has had a long and debilitating effect on medical provision to the rural poor.

Rural communities in South Africa are characterized by a high level of health problems both in endemic diseases such as tuberculosis and HIV/AIDS and epidemics like cholera. These communities suffer high levels of illiteracy, unemployment, poverty, and lack access to clean drinking water and improved sanitation. They lack resources and skilled professional guidance (Dantile 2002). Rural communities are generally acknowledged in South Africa to be poorly served with health services and the incoming post-apartheid government has committed itself to creating more clinics closer to rural communities and more hospitals in rural centres accessible to the people. Despite a considerable effort over the past 10 years access to adequate health services is difficult for rural communities and many are dependent on visits by mobile clinics once a week or even lower levels of provision. A study by Green and Dube (2000) found that in order to meet health needs, rural villagers in Northern KwaZulu-Natal had to walk five kilometres to reach their neighbouring clinic. Health facilities are now free for mothers and children under six, and when this ruling was introduced there was a considerable increase in attendance at the clinics. The clinics are, however, at times, poorly staffed and poorly resourced and referrals to hospitals generally difficult as there are often communication and transport difficulties and charges associated with hospital attendance.

There are very low numbers of doctors and medical professionals in rural areas and a high turnover of staff in the hospitals. The secondment of large numbers of Cuban doctors to rural practices has been an attempt to stop the gap and improve rural health standards. A fierce debate rages on the most appropriate policies to attract doctors to rural communities; the government has established a two year practice for interns as part of their course work, but the medical associations argue that more attractive packages should be offered to doctors to encourage them to stay in rural practice.

In addition to the lack of medical personnel there is also little provision for inspection by Environmental Health Officers who responsible for health inspection and assessment of health risk factors and who are based in urban areas and are not found in rural communities even on an occasional basis. This implies that in rural areas infrastructure for health promotion is inadequate. In KwaZulu-Natal the policy of providing health workers close to communities has been proposed to provide immediate relief to the rural poor while services are being upgraded. The Community Health Workers (CHWs) are not health professionals nor ‘barefoot doctors’ (with the right to dispense some medicines) but are individuals chosen by the community to act as useful resources for community based health programmes. The first CHW initiatives were developed in response to the need for adequate health services not supplied by existing health services in poor communities. Altogether some 2 800 CHW have now been employed and operate in rural communities in the province (KZN Department of Health, 2000).

Their scope of activities includes home visits to educate households about the prevention and facilitation of control of endemic diseases such as TB and epidemics such as cholera. The norm for deployment CHWs in deep rural areas is 1 community health worker per 100 households, although in fact the proportion in various communities varies enormously.¹ Within Community Based Health Programmes, CHWs are ideally placed to establish strong links with other sectors such as agriculture, housing, sanitation and water supply which impact on community health and development. According to Cruse (1997) CHWs promote community organization to confront the basic causes of ill health as they themselves are part of the community and experience the same health problems. CHWs are expected to have specific roles, be responsive to needs of their communities and be well supported by the rest of health services and other sectors working for community health and development.

The roles CHWs in health promotion are to make primary health care fully available to their communities through: distributing and capturing health information, mobilizing people to determine their health needs, to take greater responsibility of their health which includes advocating for appropriate resources and services. In addition it appears that the CHWs assist mothers get childhood grants for under 6 year olds

¹ In the document cited above the coverage varies from 1.5 to 30% of rural areas where they are deployed.

and disability grants for those living with AIDS. The CHWs complain frequently of a lack of resources to communicate with departments in the nearby towns.

Background: the social basis of rural health

The poor living in rural communities are generally vulnerable to water borne diseases because of uneven coverage of projects providing clean drinking water and even worse provision of improved and safe sanitation.

Water and sanitation surveys conducted in South Africa, have shown that a significant number of rural communities have only a limited or no access to reliable and safe drinking water supply. To meet their daily water needs, rural communities draw water from unprotected water sources. The rural communities of KwaZulu-face the largest backlog in water and sanitation services in the country. KwaZulu-Natal rural population constitutes some 50% of the total number of South Africans not accessing piped water. There are severe backlogs particularly in sanitation with 337 119 households not having any sanitation and 583 115 households having unimproved sanitation in the form of latrines (STATSSA 2001).

In addition to a considerable lag in the provision of water services in KwaZulu-Natal and, as importantly *free* basic water, there are also other deficiencies. It is important to know that there is no regular surveillance of water quality generally (although testing facilities are available). In addition there is considerable research establishing there is a high level of parasitic infection in populations particularly in the coastal zones. A program conducted in the schools to eliminate parasite infections through coordinated departmental activity has failed; after initially bringing about a dramatic decline in incidence of infection, the levels now have returned to pre-treatment levels.

Lack of access to basic water supply and sanitation facilities is one reason for black South Africans suffering by far the highest infant mortality and water-related disease rates in all of Africa. 18 000 people in South Africa die from diarrhoea or dysentery every year. It costs the country approximately R4 billion every year to treat and cope with the effects of water borne diseases (Rural Development Services Network, 2000).

Even where there are community water supply projects there are problems encountered by poor families accessing the minimum water consumption (25 litres per person per day) set out in regulations. In the rural areas individual consumption daily rarely reaches this level except where there are yard connections. Reasons for low or no clean drinking water consumption include issues of affordability at either the flat rate contribution or metered water supply, and an unwillingness to pay for communal standpipes (RSDN, 2000). This has now been partially alleviated by the provision of free basic water, but there are still continuing problems in rural communities of other kinds. Communal standpipes are not always seen as a significant improvement on existing sources of water as, at times the water does not taste good, taps may be very distant from homes, projects are poorly designed, areas within communities are without service and intermittent supply (Hemson, 2003). A survey of community water projects in KwaZulu-Natal by the HSRC found that half of the projects were not functioning to the RDP standard of provision within 200 metres from the homestead. Few of the projects provided water at the statutory level of 25 litres per person per day, and most provided much lower levels of consumption between 8-12 litres per person per day. About 20% of the projects were not operating at the time of the survey (Hemson, 2003:).

At the time of the epidemic a "full cost recovery" approach was being taken in principle in providing water services to the poor, poor households stood less chance of getting access to safe drinking water particularly where under the previous apartheid administration water was provided in a number of areas without charge.

Since the transmission of many of the water-related diseases depend on access of human wastes to domestic water or people's mouths, the chain of transmission can be broken by safe disposal of human excreta, improving water quality and quantity, improved personal and domestic hygiene and preventing recontamination of water supplies (RDSN, 2000).

To achieve a health impact, improved water and sanitation and better hygiene behaviour are required. Yet these are extraordinarily difficult to demonstrate on a project level, and for a variety of reasons water projects been shown to have no or little health impact or in some cases worsen the situation. Some

explanation can be offered; there are often water interruptions, many are excluded from the operation of the scheme because of distance or deep poverty, and sanitation and effective hygiene education has notoriously lagged behind water delivery. It has been argued (Hemson 2003) that there is a minimum consumption of water on average necessary for the health impact to be available in terms of hand washing and other aspects of maintaining cleanliness.

The evidence of higher levels of service generally leading to improved health is incontrovertible; calculations made on the Demographic and Health Survey of 1998 that both water and sanitation have an acute effect on child mortality rates:

For those households which do not have piped water the child mortality rate (4q1) is twice as high (from 11.6 to 27.7); and

For those households which do not have flush sanitation the child mortality rate (4q1) is four times as high (from 7.7 to 34.9). (Department of Health, 1998).

The solution to these evident problems of social medicine is the implementation of rapid implementation of rural services to provide basic needs, but there have been difficulties in marshaling the resources and sustaining commitment as has been shown in the programme to eliminate parasitic infections.

Outbreak and epidemic

South Africa has had a history of cholera epidemics and it has been argued that cholera is endemic to the country. Before the most recent epidemic there were various warnings of the danger of microbial diseases particularly in rural areas. The Institute for Water Quality Studies issued a report in 2000 which analysed data on poverty and level of water and sanitation in communities and produced a map which was remarkably accurate in its indication of the areas most at risk (IWQS, 2000). In addition a researcher with the CSIR conducted a study of the sewage effluent from rural hospitals and identified the cholera bacillus in a paper presented to a national conference of engineers well before the outbreak (Simpson, 2000).

Unfortunately the public health system was not well prepared for the eventuality in late 2000. While the epidemic raged largely in the rural areas, its epicentre was in the outskirts of the industrial region expanding most rapidly in KwaZulu-Natal; the Empangeni-Richards Bay industrial complex. The first case was confirmed in the informal settlement (or to use the Millennium Development Goal term 'slum') of Madlebe on the 14th August 2000; significantly this was not in a rural context. Although in popular imagination epidemics are associated with neighbouring countries there is no clear linkage incidences in neighbouring countries (like Mozambique) or to travel in the initial phase and it appears to be shown to be endemic.

All these issues are highly relevant to the course of the outbreak and epidemic. In rural communities where these water supply services are provided, there appeared to be a conflict between the government's insistence on full cost recovery approach and the economic status of the communities. A study by Cottle and Hameeda (2002), found that the conversion of nine previously free water, communal standpipes to pre-payment meters, in the rural Ngwelezane/Empangeni municipality, resulted in many poor households being denied clean water supply. The conversion was equivalent to a water cut-off. In 11 wards of Madlebe Tribal Authority of this municipality, water cut-offs increased the vulnerability of communities to water borne diseases such as cholera as they resorted to unpurified water sources.

There is strong evidence that cholera was spread through contaminated rivers; the installation of pre-paid metered standpipes acted to force the people to use the suspected Umfolozi River as well as highly polluted streams within Madlebe.

The disease spread with extraordinary speed. From its inception in Madlebe doubled and then trebled. Numbers increased partly by spreading to new areas; and for a considerable period the strategy of containment and eradication did not succeed.

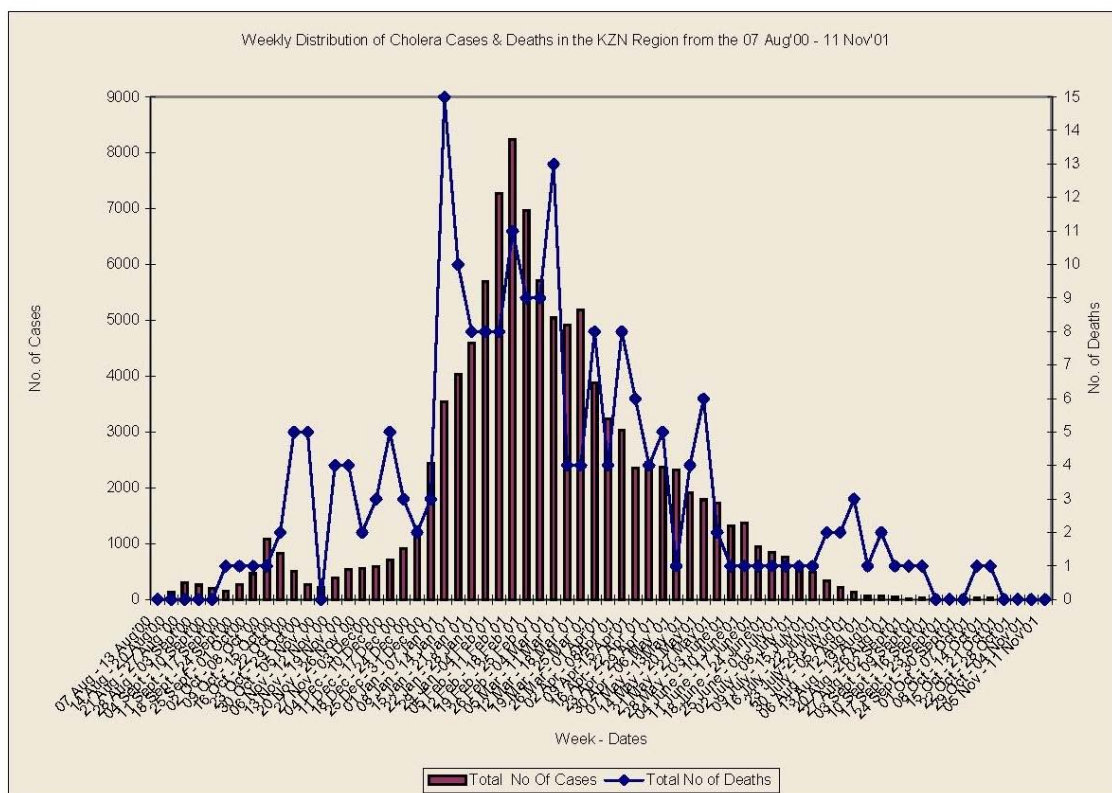


Figure 1: Incidences of cholera –August 2000 to November 2001

In 13 months period of the cholera outbreak, there were 114 000 cases reported which resulted in 260 deaths in the nine provinces although the vast majority were in the province in which it originated. There was, by various comparative standards, a fairly low level of mortality (at 0.31% of those infected), but a high incidence.

Early in the course of the epidemic the public health measures adopted appeared to have succeeded. In a paper prepared for an international conference on poverty mapping, it was stated that the power of mapping poverty, illiteracy, low levels of service, etc, had led to the optimal interventions and had had the effect of stalling the epidemic (Babita and Ozler, 2001). But in the subsequent months the spread of the epidemic appeared unstoppable even though the level of incidence declined. It was clear that the both the interventions and the messages put over were not having the desired effect. There were emergency meetings between the Ministers of Water Affairs and Health early in 2001 and later that year to ensure that there was a more adequate response.

At the height of the epidemic there was a continued reporting of high number of cases (daily average 280-300), and the epidemic spread by areas and months in spite of considerable efforts at control. In the table below it is shown that in the first 12 months, in addition to KwaZulu-Natal, another 7 provinces were involved and more than 100 000 patients were treated; putting a considerable burden on the health system.

If it were not for the intervention of the SA Military Health Service (SAMHS) there would have been a very deep crisis in the health system and a much higher death rate. The public health intervention through the military who were called on as the Department of Health could not cope with the high numbers of cases presenting at clinics and hospitals. This was a high cost intervention with helicopters being used to transport patients to dedicated clinics and the military was key to setting up 70 rehydration clinics. SAMHS brought in helicopters and medical team, ambulances and medication and on average they treated more than one thousand patients a day from not less than 98 000 cases, or some 90% of the cholera patients, during the first 12 months of the epidemic (Crowther, 2001).

Table 1: Cases of cholera epidemic in South Africa: 2000-20031

Period	No. of provinces affected	Total number of cases reported	Total number of deaths reported	Rate %
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15-Aug-2000 to 31-Jul-2001	8	106,389	229	0.2
01-Aug- 2001 to 13- Dec- 2002	6	18,224	122	0.7
01-Jan-2003 to 5-Dec-2003	5	3,855	44	1.1
Total		128,468	395	0.3

Source: Department of Health website.

In the subsequent period infection continued in 6 provinces but at a substantially lower rate, and in the period from January 2003 to date the numbers have fallen considerably, although it is also evident that a number of provinces have populations which are still susceptible. There are continuing small outbreaks in the Eastern Cape and in KwaZulu-Natal which indicates that although the epidemic has ended, the conditions which allow the bacterium to breed continue to exist.

What is significant from the data is that the death rate of those infected has risen over time, implying that the rapid response initially generated by the epidemic was relatively successful but that the spread of the disease to new areas found the health authorities less prepared. The overall death rate for the entire period was in the order of less than 1 per cent of those infected.

By way of contrast the epidemic of cholera in Mozambique had infected 159 people over 3 provinces in the period 25-Dec-2003 to 07-Jan-2004 over with 6 deaths giving a death rate of 3.8% of those infected (IRIN,2003). A country with much greater resources such as South Africa could cope better with the epidemic. Significantly there is a much lower rate of infection than in South Africa showing a much slower velocity of transmission of the bacterium to new areas.

Disaster management

The sharp escalation in the epidemic despite the counter measures undertaken by the Department of Health and Water Affairs raised questions about the efficacy of the intervention and the reception of key messages about the disease in rural communities. The management of the disease moved from being that of accelerated activity within the existing institutional structure to an emergency or disaster mode of operation. At this point coordination between departments became critical and disaster committees were set up in key areas. The WHO was also invited to send experts to assist in the intervention.

Table 2: Disaster management in South Africa

An **emergency** is understood as a sudden unforeseen crisis (usually involving danger) that requires immediate action¹; but action which deals with a temporary state, continuing for a limited time.
Emergency medicine [n] the branch of medicine concerned with the prompt diagnosis and treatment of injuries or trauma or sudden illness.

“disaster” means a progressive or sudden, widespread or localised. natural or human-caused occurrence which

- (a) causes or threatens to cause-
 - (i) death, or disease;
 - (ii) damage to property, infrastructure or the environment; or
 - (iii) disruption of the life of a community; and
- (b) is of a magnitude that exceeds the ability of those affected by the disaster to cope with its effects using only their own resources;

“disaster management” means a continuous and integrated multi-sectoral, multi-disciplinary process of planning and implementation of measures aimed at-

- (a) preventing or reducing the risk of disasters;
- (b) mitigating the severity or consequences of disasters;
- (c) emergency preparedness;
- (d) a rapid and effective response to disasters, and
- (e) post-disaster recovery and rehabilitation;

chapter 1

In the response to the epidemic the disaster committees required by their nature inter-departmental cooperation which is not a feature of South African national public administration either in the apartheid period or since. In the Development Facilitation Act there is, however, the requirement that each municipality should provide an Integrated Development Plan to bring together all the elements of service delivery, public works, and health services. Thinking and planning on these lines is, however, at a very early stage, and the declaration of a disaster was an attempt to rationalize the response and get the greatest efficiencies in breaking the onrush of the disease.

Transmission and reaction

Cholera is spread by contaminated water and food. Sudden large outbreaks are usually caused by drinking contaminated water from unprotected sources (WHO, 2000). The communities most at risk from water-related diseases are, those who are poor, those with poor or no sanitation services who are forced into bush toileting – often along the banks of rivers, and those who rely on untreated water directly from rivers for their drinking water and for washing purposes. The cholera bacterium therefore spreads by people drinking contaminated water. The following diagram illustrates how people without access to proper water and sanitation facilities get infected by cholera pathogens.

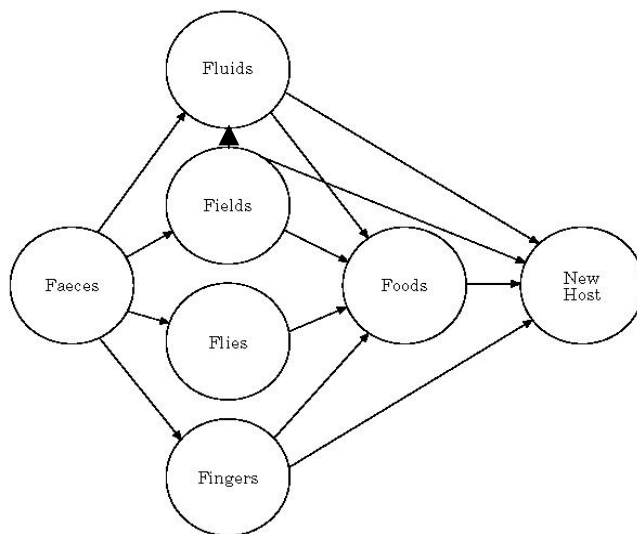


Figure 2: The F-diagram: illustration of various pathogen transmission routes

Source: Curtis V, Cairncross S, Yonli R (2000).

The F-diagram illustrates the different transmission routes that faecal pathogens take through the environment: fields (soil), fluids (drinking water), flies, fingers and food to reach a new host. Most of these transmission routes occur in the domestic domain and can be prevented by provision of water and sanitation facilities in conjunction with good domestic hygiene behaviour.

In a context of poor access to clean water supplies and basic sanitation facilities, the faeces -field-fluids transmission route illustrates that faecal matter that is deposited in open fields can contaminate the environment when it gets washed away into unprotected water sources (fluids). The contaminated water can be drunk without any purification or used in food preparation by people who do not have access to safe water supplies. This transmission route can be blocked by the provision of water and safe excreta disposal

facilities (toilets). If toilets are constructed and used properly they can prevent faeces from contaminating the water sources. Also if people have access to safe/clean water supplies, they are less likely to use contaminated water from unprotected sources, provided good domestic and personal hygiene is practiced to prevent water contamination in transit and at storage in the home (depending on the type of safe water provided).

The faeces-flies- food- new host transmission route illustrates that flies are likely to land on excreta deposited on open fields especially by young children nearby households and then carry faecal pathogens to uncovered foods or surfaces or utensils that are used for food preparation or eating, inside a house. This also highlights the necessity for safe disposal of excreta and maintaining domestic cleanliness to avoid flies.

The faeces-fingers-foods-new host transmission route illustrates that after disposition of faeces either on the open field or in the toilet, some faecal pathogens may get onto a person's fingers during anal cleansing or after changing a nappy and into foods when hands are not washed before preparing food, eating, feeding an infant, or before touching drinking water. This transmission route could be blocked by washing hands more particularly with soap to remove faecal matter after contact with stools. This transmission route also emphasizes that water and sanitation infrastructure can only be effective in preventing water-related diseases, in conjunction with safe domestic and personal hygiene practices (Cairncross, 1990 cited in Curtis *et al*, 2000).

All the transmission routes originate from faeces which are the primary route through which pathogens get into the environment. Therefore, a primary barrier could be the practices to block this route, such as disposal of faeces in such a way that they do not get into human or animal contact. This could be achieved by making use of latrines, sewers etc and the removal of traces of faecal matter after contact with human excreta.

With full implementation of water services in rural areas the following would be achieved:

Faeces	⇒	Sanitation	Pathogens isolated
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In response to the various forms of transmission, the public authorities proposed various counter measures.

Table 3: Cholera transmission and public health intervention

Transmission			Reception of message -- intervention
Faeces	⇒	River/stream	Use of clean drinking water from protected springs, public standpipes, yard connections
			Use of alternative source: tanker
			Purify water: boil, bleach/chlorine
Faeces	⇒	Contaminated container	Hand washing and short storage
Faeces	⇒	Contaminated food	Hand washing

In the subsequent parts of the paper the interventions and responses of the rural population to messages will be analysed.

Health promotion in rural communities

The national policy for health promotion practice in South Africa established five key action areas for health promotion practice. One of those areas is to promote safe environments for people to live and work. In rural communities many health problems are caused or made worse by living in poor conditions, for example, having poor water and sanitation facilities or dangerous energy fuels

Coulson (2000) argues that it is more effective to promote health *outside* the health sector than within. For example, the government AIDS partnership strategy acknowledges that people are best reached through all

channels in the community not just at the clinic. In rural areas where access to health promotion services is inadequate due to poor communication and transport facilities, unattractive environment to professionals a health promoting schools project could be a good example of a programme of health action outside the health sector and the role of the health system could be that of setting targets and guidelines and provide leadership and strategy.

Reports on the review of cholera outbreak in rural Northern KwaZulu-Natal do not specify the roles of CHWs in the relief measures undertaken by various sectors; in some areas the CHW were extensively deployed as assistants to hospital and clinic intervention, in others they were largely on their own in passing on health messages. The question arises as to how effective CHWs are in promoting health through mobilizing people to determine their health needs and advocate for appropriate health resources and services in impoverished rural communities. A researcher who has evaluated the CHW program regards the work of the CHW as critically important in understanding their communities and those most at risk, relaying messages to communities, and providing channels of communication from the community to the agencies involved in cholera control.² Despite this none of the official literature mentions the work of the CHW or comments on how messages were received by communities.

It is also clear that the conditions in which the CHW operated varied enormously; generally they were closely linked to a local hospital and ran, for a period, a hospital extension service. In other areas more distant from a hospital the CHWs appeared to be very much on their own and operated as best they could without specific materials or equipment. In Thaleni, in the Nkandla District, the local CHW was strongly motivated and visited each household virtually carrying out an inspection, chiding those without a pit latrine and passing on messages about cholera.

There were not reported to be cholera cases in this remote area served by a spring water project. In some communities where there were no existing CHWs these were recruited and given quick instruction in their tasks (usually limited to identifying patients to come to rehydration centers). These CHW now feel a sense of resentment to the work as they have not been engaged by the Department of Health to continue the work of health promotion as have other CHW.

A team of 10 CHWs in Macabuzela ward in Hluhluwe serves 14 078 households for 15 days a month. During and after cholera outbreak these CHWs were involved in teaching communities about protecting themselves from cholera and the appropriate treatment. They distributed cholera pamphlets to communities and demonstrated how to make Oral Rehydration Solution especially for illiterate mothers. During community visits, CHWs gave attention to encouraging people to construct pit latrines, use safe water and practice good personal and domestic hygiene.

During and after heavy rains these CHWs make repeated visits to those households that do not have access to safe water. After every day's work, each CHW filled in a duty form kept by a CHWs monitor who then reports to the CHW facilitators in clinics/hospitals. During a cholera outbreak, one of the marvelous duties of the CHWs is to report cholera incidences and deaths to the hospital, which helps to identify high-risk communities.³ However, there did not seem to be a 'settings approach' in which various settings are identified to carry specific messages through to the community (Coulson et al, 1998:147). From interviews with CHW and research visits to affected areas it appears there has been no integrated cholera awareness programme between the Department of Health (CHWs) and the Department of Education (local schools) as CHWs visit households only. As significantly there is also no mention in interviews and visits of the Environmental Health Officers of the Department of Health and of municipalities responsible for health promotion and inspecting environments dangerous to health.

During the cholera outbreak in KwaZulu-Natal, the World Health Organisation encountered shortages of health-promotion workers, ineffectiveness of education program, lack of community involvement in education efforts, and over-pressurized hospitals. Morris (2001) found that despite emergency education, some residents continued to use the contaminated river as their only source of water. This situation is familiar to the majority of residents living below the poverty line in affected areas throughout the country.

Obstacles and issues in transmitting messages

² Personal communication, Dr Jane Kvalsvig.

³ Telephone interview: Sister Ndaba, 20 February 2004.

A poverty map shows that the 2000-2001 cholera outbreak originated in areas of very high poverty and spread through and towards other poor areas (Statistics South Africa, 2001). The spread of cholera continued despite emergency cholera health messages through media and practical community demonstration campaigns. This implies the difficulty in understand cholera health messages.

In the case of the cholera epidemic messages were readily relayed in radio (in Zulu) and television (in Zulu in the English channel and English on the SABC1 channel). At a shopping chain pamphlets were available in Zulu and English carrying the same messages. From the

Soon after the outbreak the Department of Health and that of Water Affairs launched a public campaign of information urging rural people to take measures to protect themselves from the disease.

Figure Messages for change? Updated in 2003

To Prevent Cholera

Use only clean, treated or boiled water.

Wash all raw food with clean, treated or boiled water

Wash your hands before handling or eating food

Wash food utensils in clean, treated or boiled water

Protect food from fly contamination and prevent fly contamination in your homes

Use proper toilet facilities only and wash hands after use.

Do not allow children to play in dirty pools, rivulets or storm water outlets

Do not contaminate rivers or leave sewage where it can be washed into a river by rain

Do not allow children to play in dirty pools, rivulets or storm water outlets.

Source: KwaZulu-Natal Department of Health, 2003. <http://www.kznhealth.gov.za/cholera.htm>

These messages were unexceptional, but they were based on assumptions firstly that there were sufficient facilities to boil water (many other messages insisted on boiling for some time) and that bleach was available and that people could afford it, secondly that 'proper toilet facilities' were available in rural communities as well as hand washing facilities nearby, and finally that there were some alternatives to defecation in the fields. In fact all the above were highly improbable.

There was also fairly extensive use of posters and pamphlets to spread the message about practicing good hygiene: an example of which is presented in the figure below.



Figure 3: Cholera poster detail

Source: SANTAG, 2000

Studies show that there are still high illiteracy levels in rural areas (Dantile, 2002). Therefore, one of the effective ways to communicate health messages is through posters with clear and understandable illustrations. The cholera poster illustrates washing of hands using a hand washing facility after visiting the toilet. Results from sanitation surveys conducted in rural communities in KwaZulu-Natal found that hand washing facilities and toilet paper holders did not appear to be part of the sanitation designs (Hemson, 2003). A survey by Venter-Hilderbrand (2003) after the 2000 cholera outbreak in Newcastle, found that

none of the households surveyed had dedicated hand-washing facilities and they used a washing basin or bucket for hygiene purposes. They use the same water from the drinking water container. No water is kept aside for the washing of hands. Where water is poured, immediately after using the toilet, the habit of applying soap was not evident. Therefore, such an illustration may not have the desired effect, instead people would use dirty hands to draw water from household containers, which might result in water contamination at storage. In all the households surveyed, water-drawing mechanisms (cups or jugs) were used. However, they were all left out in the open and prone to contamination. In some instances the cups or jugs were lying in the dirt. There was no evidence that soap was being used (Venter-Hilderbrand, 2003).

The cholera poster shows the use of a gas cooker to boil water. The use of gas cookers is uncommon in some deep rural areas, due to their low economic status. A study by Green and Dube (2001) found only 12% households using gas cookers specifically for ironing purpose and 89% using wood (fireplace) for cooking and boiling water in rural Northern KwaZulu-Natal.

It is very difficult for rural people to meet some of these criteria. Boiling of water to kill germs is expensive and highly depends on the availability of fuel. As in case of rural Northern KwaZulu-Natal where the main source of fuel (for cooking) is wood (Green and Dube, 2001), more burden of wood collection is on rural women, who themselves are more likely to be affected by cholera (might be weak during the outbreak). The question also arises as how many litres of water could be boiled to meet the increased water consumption for 6 (average) members of a rural household (Dube, 2000).

As rural people have indicated the inability to pay for water services, the question arises as to whether can they afford buying litres of bleach for daily water purification in a long-term basis?

A study by Dube (2000) found that the provision of clean water to developing communities did not necessarily correspond to an increase in the use of water for personal hygiene. The contributing factor to poor personal hygiene even when water is easily available is the lack of washing/ablutions facilities (Hemson, 2003). Therefore, rural people scoop water from open buckets/containers (using dirty hands) in order to wash hands (Dube, 2000). Therefore, hand-washing practice where there are no proper ablution facilities may further spread the disease through water contamination at storage.

A number of studies of hygienic behaviour is to prevent the transmission of the agents of infection have concluded that it is difficult to get people to change to hand washing with soap which could save millions of children's lives (see for example Curtis, 2003). During critical moments, such as food preparation and handling children's faeces, it has been found that few people wash their hands with soap. It appears that health is not high on people's priorities even when they do. The international WASH campaign is designed to work with soap companies to improve communications and change such behaviour, a new combination of 'social' and 'for-profit' marketing! Behaviour, it is argued here, is conservative not only because of a lack of information of the cause and effect of the transmission of pathogens, but also because in poverty either sufficient water is not available, or there is no soap, or finally no facility to wash hands.

Even when people have been exposed to these messages, reports show that many people return home after treatment for cholera and drink contaminated water, hoping that they are immune after treatment (SANTAG, 2000).

A study by Dube (2000) found that hand washing after visiting the toilet is regarded as a norm, that is passed on from generation to generation. One woman said she washes her hands after visiting the toilet because her grandmother taught her so and her mother also did too, and she was passing the same message to her children. In this case, hand washing after visiting the toilet is regarded as something that one has to do as adults have taught him/her, regardless of its importance in relation to health.

Water collected from tankers deployed by DWAF is likely to be vulnerable to faecal contamination via fingers as it transported home, stored and use. A study by Kirchhoff *et al* (1985) (cited in Curtis, Cairncross and Yonli, 2000) found that heavily contaminated water in the home and chlorination to remove it had no effect on diarrhoea incidence.

The inter-departmental intervention in the deep rural areas very largely drew on the prior initiative of the Department of Health in the province in setting up a system of Community Health Workers. The effectiveness of cholera health messages is more questionable than their dissemination.

Lack of active participation by other public sectors (e.g. education) despite repeated notification of the outbreak, e.g. education, may result in the failure to control the spread of cholera especially in children at schools. Through observational visits to the affected areas, researchers found no indication of cholera awareness education (there were no cholera posters observed in schools (Hemson, 2003). This implies that though these messages are communicated in the community, school going children are at risk of being affected at schools as water and sanitation survey in KwaZulu-Natal schools has shown lack of access to clean water and poor sanitation facilities at schools. Where water was accessible, there were no ablution facilities as a result water use was limited to avoid wastage (Hemson, 2003).

Rural young people and women are less likely to carry purified water with them when they fetch water, wood or herd livestock, chances are that they can drink from contaminated streams during these chores.

It is recommended that these health messages be built on existing rural sanitation and domestic infrastructure, and indigenous knowledge/motivation for hygiene. It is also recommended that an evaluation programme be conducted to assess evidence of behaviour change following the hygiene messages. Therefore, hygiene behaviour/health monitoring indicators should be developed to help refine health messages and to assess the correlation between knowledge of cholera prevention and behavior, so as to increase their efficiency.

Schools: centre for learning and change?

Schools which are a government provided public facility for rural communities could be a major point of entry for health promotion and good practice, educating a new generation in good hygiene and creating the expectations that their homes should have the same conditions if not better.

The provision of safe water and sanitation facilities in schools is a first step towards a physical environment that benefits both learning and health. However, the mere provision of facilities does not necessarily produce the desired impact. It is people's use of latrines and related appropriate hygiene behaviour that provides health benefits. In schools, hygiene education promotes practices that help to prevent water and sanitation-related diseases as well as encouraging healthy behaviour in the future generation of adults (International Water and Sanitation Centre, 2003).

How do rural schools measure against conditions which should apply? A study by Mqadi (1999) of schools in Gauteng Province found that school toilets were in bad conditions and were breeding places for germs. Many learners preferred not to use the toilets unless absolutely necessary, because they feared contamination from the unhygienic state of the toilets. A survey by Hemson (2003) examines the conditions of water and sanitation in schools within the area of 23 water projects evaluated in KwaZulu-Natal province. Altogether concluded that the majority of rural schools now have sanitation but the facilities are often poorly constructed, abusively used, and were inadequate for the number of learners served. Hand washing facilities did not appear to be part of the school sanitation design. On the only school visited at which hand-washing facilities existed, learners were unable to use them since there was no running water in the school. Some school heads had made some efforts to improve the unsanitary conditions of the school's toilets but they received little help from both their district municipalities and the Department of Education. Following the cholera outbreak, the Department of Health provided schools with 300 000 copies of SANTAG's cholera material, to initiate a child-to-child action project approach. However, it was not clear how these materials were used in classrooms.

Bundy (2003) says, "Hygiene education in schools is meaningless without clean water and adequate sanitation facilities. In order to reduce the spread of diseases carried by water supply, schools should have access to clean water and adequate sanitation. By providing these facilities, schools can reinforce the health and hygiene messages and act as an example to both pupils and the wider community".

Despite these evident difficulties an inter-departmental intervention was sustained for the duration of the epidemic, drawing in addition the military, the local Red Cross and other agencies in a common effort; an example which was later recalled by health practitioners who were struggling to deal with the HIV/AIDS pandemic. Some idea of the initiatives and division of responsibilities is provided below in the table. In addition a number of commercial firms carried pamphlets in shops and provided a subsidy to their sales of bleach.

However, the CSIR (2003) argues that a large emphasis was placed on water supply rather than on sanitation initiatives, as the need for water outweighed that of sanitation.

Kinds of water containers that people use to collect from water tankers- open buckets, top screwed containers make water prone to contamination. Water collected from distanced tankers is less likely to meet increased water consumption needs. The amount of water collected from tankers is less likely to meet the increased water consumption needs, as it highly depends on availability of healthy household members to carry water from the tanker to the household.

Lasting lessons?

The 2000-01 cholera epidemic demonstrated inadequacies in rural health and rural development in South Africa. The cholera epidemic succeeded in the short term through emergency measures in mobilizing all agencies involved in rural development and public health in a common initiative. The problem has been to see this initiative sustained and for the messages presented to be lasting to bring a change in the health conditions particularly of rural children living in poverty.

Despite the considerable considerable effort made in anti-cholera campaigns, the WHO (2002) reported that the response to cholera outbreaks in South Africa tended to be reactive in the form of interdepartmental emergency response rather than a longer sustained initiative. Even in its relative success there were constraints and difficulties in the inter-departmental intervention particularly in the more remote rural areas. Unfortunately it is not clear whether the interdepartmental unity and common effort which was assembled for a period around emergency water and sanitation delivery and health promotion is leading to concentrated and durable attention to the problem.

One of the lessons of the International Drinking Water Supply and Sanitation Decade was the recognition that the communities need to play an important role in the planning, implementation and operation of the water and sanitation facilities to ensure a long-term sustainability of services. Community participation must begin with the planning stage for an example communities must determine what they are willing to pay or able to pay for and how services will be in democratic control. Also if the communities are involved in the management of water and sanitation facilities, they would be likely to develop a high level of satisfaction with these facilities which they would regard as their own and which would reduce vandalism.

South Africa exhibits the problem of slow growth, rising wealth, but lasting and deepening inequality between rich and poor which is evidenced in very uneven access to basic services and basic needs. In attempting to break out of the colonial political economy, the society still contains all forms of combined and uneven development; combined in the sense that the latest technique and cosmopolitan fashion is adopted in the urban centers while the legacy of colonialism and apartheid persists in the impoverished rural areas.

The task of health promotion is tied to the democratization and development of impoverished areas and rural communities are waiting for the voice of health professionals to be heard on these matters.

Bibliography

- Ashpole, M. (2001). Cholera risks in well-serviced environments. *Imiesa*, 26, 13.
- Athan, E. D. E. & Durrheim, D. (2004). A cholera outbreak and control in a rural region of South Africa. *South African Medical Journal*, 88, 1306-1307.
- Baber, P. (2001). Cholera awareness programme in North West province. *Civil engineering*, 27.
- Babita, M. & Ozler, B. (2002). *Experiences with the development and use of poverty maps: case study note for South Africa*.
- Baez, C. (1999). *Oral rehydration therapy corners and the management of diarrhoeal illness in children* Health System Trust.
- Bailey, I. W. (2004). Cholera epidemic in South Africa.
- Baloyi, O. (2000). KwaZulu-Natal policy document on community health workers. KwaZulu-Natal Department of Health.
- Bateman, C. (2000). KZN 'on the mend' from cholera. *South African Medical Journal*, 90, 1166-1167.
- Bateman, C. (2001). Country's sorry sanitation saga : izindaba. *South African Medical Journal*, 91, 96-98.
- Bateman, C. (2001). Sharp eyes on cholera flashpoints. *South African Medical Journal*, 91, 278-279.
- Bateman, C. (2002). Doctors overwhelmed at the AIDS coalface : izindaba. *South African Medical Journal*, 92, 402-403.
- Bateman, C. (2002). Mozambique cholera will affect region : izindaba. *South African Medical Journal*, 92, 104-106.
- Bradshaw, D., Bourne, D., & Nannan, N. (2003). What are the leading causes of death among South African children? Medical Research Council.
- Bundy, D. A. P. (2003). Focusing resources on effective school health: a fresh start to improving the quality and equity of education. In D.Crompton, A. Montresor, M. Nesheim, & L. Savioli (Eds.), *Controlling disease due to helminth infections* (pp. 99-105). World Health Organisation.
- Burger, S. E. & Esrey, S. (2000). Water and Sanitation: health and nutrition benefits to children. In S.Huffman & Steel A (Eds.), *Water and Sanitation* (pp. 153-175).
- Cauvin, H. E. (2000). South Africa ask for help in cholera outbreaks: thousands are ill and 59 are dead. *Nature*, 404, 331-332.
- Clarke, E. (1998). Policy in progress. Health Sytem Trust.
- Cloete, T. E. & Venter SN (2001). Cholera outbreaks in South Africa part of an ongoing global pandemic : water quality. *SA Waterbulletin*, 27, 12-13.
- Cottle, E. & Deedat, H. (2002). *The cholera outbreak: a 2000-2002 case study of the source of the outbreak in the Madlebe Tribal Authority areas, uThungulu Region, KwaZulu Natal*.
- Coulson, N. (2000). Health promotion in South Africa. *Up Date*.
- Council for Science and Industrial Research & Human Science Research Council (2003). *Review of cholera interventions strategies in KwaZulu-Natal South Africa* Pretoria.
- Crowther, I. (2001). Saluting the SAMHS's involvement in cholera prevention and treatment in KwaZulu-Natal. *Milmed*, 17, 18-19.
- Cruse, D. (1997). Community health workers in South Africa: information for provincial policy makers. Health System Trust.
- Curtis, V., Cairncross, S., & Yonli, R. (2000). Domestic hygiene and diarrhoea -- pinpointing the problem. *Tropical Medicine and International Health*, 5, 22-32.
- Curtis, V. (2003). Talking dirty: how to save a million lives. *International Journal of Environmental Health Research*, 13, 73.

- Dantile, Z. (2002). Provision of physiotherapy services in the rural areas. In (pp. 1). Melbourne.
- Deedat, H. & Cottle, E. (2002). Cost recovery and prepaid water meters and the cholera outbreak in KwaZulu-Natal: a case study in Madlebe. In McDonald DA & Pape J (Eds.), *Cost recovery and the crisis of service delivery in South Africa* (1st ed. ed., pp. 81-97). Cape Town: Human Sciences Research Council.
- Department of Education (2001). *Guideline for cholera control*.
- Department of Health (1998). *South Africa Demographic and Health Survey - 1998*.
- Department of Water Affairs and Forestry. (2002). KwaZulu-Natal cholera relief.
- Dubb, A (1979). Cholera:in history. *Alder Museum Bulletin*, 27, 1-3.
- Dube, N. B. (2000). *Water usage and hygiene practices of two peri-urban KwaZulu-Natl communitiesd*. Honours.
- Durrheim, D. N and Keddy, KH (2001). Cholera- the grim reality of under-development. *SA family practice*, 23, 4-10.
- Durrheim, D. N., Speare, R., Billinghamurst, K., & Reich, M. (2002). Cholera- the role of catheters, confidential inquiries and early response: issues in medicine. *South African Medical Journal*, 92, 597-599.
- DWAF (2002). *Guideline for the management of waterborne epidemics, with the emphasis on cholera* Republic of South Africa.
- Fincham, J. (2001). *Helminths, HIV/AIDS and tuberculosis*.
- Glission, J. (2002). Cholera-are we getting the message through ?: briewe. *South African Medical Journal*, 92, 320.
- Green, J. M. & Dube, N. B. (2001). The perceptions and energy usage of rural villagers in KwaMajomela, Northern KwaZulu-Natal. In (pp. 90-96). Cape Town: University of Cape Town.
- Health Systems Trust. (1997). Community health workers in South Africa.
- Hemson, D. (2000). Accelerated delivery? rural women and water. *Agenda*, 45, 54-65.
- Hemson, D. (2003). *Upgrading sanitation: an evaluation of school and country initiatives* Presentation to Colloquium: Improving the health of School Age Children in an Era of HIV/AIDS,Nkosi Albert Luthuli Hospital,Durban.
- Hemson, D. (2003). *The sustainability of community water projects in KwaZulu-Natal. Synthesis report and ten district reports undertaken for DWAF* Human Sciences Research Council.
- Henninger, N. & Snel, M. (2002). *Where are the poor? Experiences with the development and use of poverty maps* Washington, DC: World Resources Institute.
- Henninger, N. & Snel, M. (2002). Where are the poor? World Resources Institute.
- Hilton-Barber, M (1998). Water if death. *Drum*, 8-9.
- Holthausen, L. (2002). The war for water. *Water Institute for Southern Africa*, 22, 26-29.
- Hoque, A. K. M. M. (2001). *Childhood mortality in KwaZulu-Natal - 2001* KwaZulu-Natal Department of Health.
- Hoque, A. K. M. M. (2002). *Cholera deaths at Ladysmith and Emmaus hospital between 25-28 January*, KwaZulu-Natal Department of Health.
- Institute for Water Quality Studies (2000). *National microbial water quality monitoring programme: a first report on the identification and prioritisation of areas in South Africa with a potentially high health risk due to faecally polluted surface water* (Rep. No. Report No: N /0000/00/RE/Q/4399).
- International water and sanitation centre (2003). *School sanitation* International water and sanitation centre.
- IRIN (2004). *Mozambique: cholera death toll may rise*.
- IRIN (2002). *Cholera vaccine*
- Jones, J. (1999). International control of cholera:an environmental perspective to Infectious disease control. *Indian Law Journal*, 74, 53.

- Koornhof, H J (1997). Cholera, dysentery and haemorrhagic colits. *Cannon Communications*, 8, 80-88.
- Kvalsvig, J. (2003). Parasites, nutrition, child development, and public policy. In D.Crompton, A. Montresor, M. Nesheim, & L. Savioli (Eds.), *Controlling diseases due to helminth infections* (pp. 54-55). World Health Organisation.
- KwaZulu-Natal Department of Health (2002). *Cholera Update*.
- KwaZulu-Natal Department of Health (2002). *Cholera Update*.
- KwaZulu-Natal Department of Health (2002). *Cholera Update, 9-11 February*.
- Laurence, P (2001). Brave new world of free water for the poor: international scepticism and scrunity of SA plan. *Financial Mail*, 36.
- Lindley, D. (2001). Could the KwaZulu-Natal cholera epidemic have been prevented? *African Wildlife*, 55, 28-29.
- Matchaba, P (2001). Cholera, aids and poverty. *Aids bulletin*, 10, 20-22.
- McDonald, K. (2001). Cholera in Eshowe : health and safety. *Civil engineering*, 9, 30.
- McDonald, K. D. (2001). Grandmothers wheeled in barrows. *Lancet*, 358.
- Medical Association of South Africa (2001). Cholera in South Africa. *CME*, 19, 268-269.
- Melanie, F. (10-8-2003). Kasrils: I'll drink from SA's dirtiest river.
- Merriam, S. & and Simpson, E. (2000). Meaning and interpretation: qualitative methods. In *A guide to research for educators and trainers of adults* (pp. 97-120). Malabar, FL: Krieger Publishing.
- Mills, J. (1986). A pilot study to assess rural water supplies and sanitation conditions on the Pongola floodplain- a social anthropological perspective. *Development Southern Africa*, 3, 479-499.
- Minnie, V.-H. (2003). *Reaching WSSCC WASH goals and attaining vision 21* Ikhwelonet Consortium.
- Mitchell, C (2000). Theresa's deadly sip of water : thirst drove her to do a silly thing: to drink from an infected river. *Drum*, 10-11-24.
- Morris, K. (2001). Prevention fails to halt South Africa's well-treated cholera epidemic. *Lancet*, 357.
- Morris, K. (2001). Cholera sweeps through South African province. *British Medical Journal*, 322, 71-95.
- Mqadi, N. (1999). Integrated school sanitation.
- Mugero, C. & Hoque, A. (2001). *Report on review of cholera situation in uLundi, KwaZulu-Natal* World Health Organisation.
- Mugery, C. & Hoque AKM (2001). *Review of cholera epidemic in South Africa with the focus on KZN*.
- Narayan, D., Chambers, R., Shah, M., & and Petesch, P. (2000). Perspectives of the poor. In *Voices of the poor: crying out for change* (New York: Oxford University Press.
- Nevando, T. & Cloete, T. (2001). The Global cholera pandemic.
- Ref Type: Internet Communication
- Oellermann, I (2002, January 15). KZN gets R25m boost to fight cholera. *The Mercury*.
- Ogunbanjo, G. A and Durrheim, DN (2001). Cholera- are we containing the crisis? *SA Academy of Family Practice*, 23, 2.
- Pegram, G. C., Rollins, N., & Espey, Q. (1998). Estimating the cost of diarrhoea and epidemic dysentery in KwaZulu-Natal and South Africa. *Water SA*, 24, 11-20.
- Phillips, R. L. (1985). Environmental health control in KwaZulu. *Community health in SA*, 22-25.
- Ray, K (2003). Water and sanitation in cities: translating global goals into local action. *Habitat Debate*, 9, 4-5.
- Ruiz, G. M., Rawlings, T., Dobbs, F., Drake, L., Mullady, T., Huq, A. et al. (2000). Global spread of micro organisms by ships. In (MacMillan Publishers Ltd.

- Rural Development Services Network (2000). *Water for all: meeting basic water and sanitation needs*.
- SANTAG (2000). Cholera outbreak in KwaZulu-Natal. *Outlet*.
- SANTAG (2001). Cholera update. *Outlet*.
- SANTAG (2001). Worms and parasite control. *Outlet*.
- SANTAG (2001). School sanitation:small project makes a big difference. *Outlet*.
- SANTAG (2002). Environmentally-friendly school sanitation. *Outlet*.
- Sapa. (200). Lesson learned from KZN cholera outbreak:Kasrils.
- Schiermeier, Q. (2001). Climate change offers bleak future. *Nature*, 409.
- Simpson, E. & Charles, K. (2000). *The health threat posed to surrounding communities by effluent discharged from rural hospital sewage treatment plants*. Presented at the WISA 2000 Biennial Conference, Sun City, South Africa, 28 May - 1 June 2000.
- South African Government. (2002). Disaster Management Act. 57.
Ref Type: Statute
- Statistics South Africa (2001). *Census results*.
- Taylor, R. K. (1994). Microbiology:virus on virus infects bacterium. *Nature*, 399.
- Theron, J. (2001). The challenge of identifying waterborne pathogens leads to new technology. *SA Waterbulletin*, 27.
- Thompson, J. & and Cairncross, S. (2002). Drawers of water:assessing domestic water use in Africa. *Bulletin of the World Health Organization*, 80.
- Vanderhoof, R. (1981). Cholera. *Community health in SA*, 9.
- Venter, H. (1998). SAMS assistance to Tanzania people's defence force. *South Africa Medical Service*, 3, 9-29.
- Water Research Commission (2003). Studies in microbiological drinking water quality. *The Commission*, 3, 16-18.
- Water Research Institute. (2001). Highlights of use and impact.
- Wessels, G. U. (2001). Cholera update- management on the ground. *South African Medical Journal*, 91, 92-93.
- White, G., Bradley, D., & and White, A. (1972). *Drawers of water:domestic water use in East Africa* Chicago: The University of Chicago Press.
- Whiteford, L. M. (1997). The ethnoecology of dengue fever. *Medical Anthropology quarterly*, 11, 202-223.
- WHO (2004). *Review of the on going cholera outbreak in the KwaZulu-Natal: findings and recommendations* Unpublished report.
- Wilkinson, D. (1993). Cholera outbreak, Hlabisa health ward, Zululand. *South African Medical Journal*, 83, 917.
- World Health Organisation. (2000). Cholera fact sheet.
- World Health Organization (1994). *The management of bloody diarrhoea in young children* Geneva: WHO.
- World Health Organization (1995). *The treatment of diarrhoea:a manual for physicians and other senior health workers*.
- World Health Organization. (2003). Guidelines for drinking-water quality. Geneva, WHO.