Communicable diseases in complex emergencies: impact and challenges

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Communicable diseases, alone or in combination with malnutrition, account for most deaths in complex emergencies. Factors promoting disease transmission interact synergistically leading to high incidence rates of diarrhoea, respiratory infection, malaria, and measles. This excess morbidity and mortality is avoidable as effective interventions are available. Adequate shelter, water, food, and sanitation linked to effective case management, immunisation, health education, and disease surveillance are crucial. However, delivery mechanisms are often compromised by loss of health staff, damage to infrastructure, insecurity, and poor co-ordination. Although progress has been made in the control of specific communicable diseases in camp settings, complex emergencies affecting large geographical areas or entire countries pose a greater challenge. Available interventions need to be implemented more systematically in complex emergencies with higher levels of coordination between governments, UN agencies, and non-governmental organisations. In addition, further research is needed to adapt and simplify interventions, and to explore novel diagnostics, vaccines, and therapies.

More than 200 million people live in countries in which complex emergencies affect not only refugees and internally displaced people, but the entire population. Although 10 million refugees are under the protection of the UN High Commissioner for Refugees and can benefit from health interventions, internally displaced people and the conflict-affected population are often dependent on weakened governments (or anti-government forces), UN agencies such as WHO and UNICEF, and non-governmental organisations for delivery of health services. In most complex emergencies, communicable diseases alone, or more commonly in combination with malnutrition, are the major cause of illness and death (see table). Notable exceptions to this rule are the complex emergencies that took place in the former Yugoslavia, Chechnya, and Georgia.

The highest excess morbidity and mortality often occurs during the acute phase of the emergency. Death rates of over 60-fold the baseline have been recorded in refugees and displaced people, with over three-quarters of these deaths caused by communicable diseases.[1] The main causes of morbidity and mortality are diarrhoeal disease—including cholera and dysentery—acute respiratory infection, measles, and malaria, with HIV/AIDS and tuberculosis becoming increasingly important.[2] Children are at particular risk; of the ten countries with the worst mortality rates for children aged under 5 years, seven are affected by complex emergencies.[3]

The excess morbidity and mortality caused by communicable diseases during complex emergencies is largely avoidable, as appropriate interventions are available. Experience has shown that, when these interventions are implemented in a timely and coordinated manner, deaths and disease are substantially reduced.

Risk factors

Many factors promoting communicable disease transmission interact synergistically in complex emergencies. These factors include mass population movement and resettlement in temporary locations, overcrowding, economic and environmental degradation, impoverishment, scarcity of safe water, poor sanitation and waste management, absence of shelter, poor nutritional status as a result of food shortages, and poor access to health care. Additionally, the collapse or overwhelming of public health infrastructure and absence of health services hamper prevention and control programmes, with a consequent rise in vector-borne diseases such as malaria, trypanosomiasis, and yellow fever, and vaccine-preventable diseases such as measles and pertussis. The control of tuberculosis and HIV/AIDS is similarly disrupted. These factors are further compounded by absent or unstable governments, ongoing conflict and insecurity limiting access to the affected populations, dearth of drugs and supplies, and multiple agencies providing health care with poor coordination.

In addition to the humanitarian imperative to protect the health of populations in complex emergencies, there are several other justifications for communicable disease intervention in such emergencies. First, there might be a resurgence of old or previously controlled diseases (eg, malaria, trypanosomiasis), and the emergence of drug resistance driven by improper and incomplete use of drugs and the absence of regulatory controls (eg,

Search strategy

The authors undertook full searches of original research reports and reviews, using MEDLINE, PubMed, EMBASE, and WHO databases. Keywords were communicable disease, refugees, population displacement, epidemics, emergencies, immunisation, vector control, shelter, and specific diseases. The authors also used unpublished data from several WHO programmes and from their own expertise and experiences with communicable disease control in complex emergencies.

bacillary dysentery and multidrug-resistant tuberculosis). Second, delays in detection, response, and containment of epidemics in conflict-affected countries represent a constant threat to surrounding countries and to the world. In 2002, 207 outbreak events of international public health importance were verified and 29% of them were recorded in countries affected by complex emergencies (WHO Outbreak, Alert and Response, unpublished). Third, countries affected by conflict represent important potential zones of new disease emergence because of delays in detection and characterisation of new pathogens and their widespread transmission before control measures can be implemented (eg, monkeypox in Democratic Republic of the Congo). Fourth, the continued presence in countries affected by conflict of diseases targeted for eradication (eg, poliomyelitis, Guinea-worm, and leprosy) represents a major threat to these goals and to the huge monetary investment in such initiatives.

Preventive measure	Impact on spread of
Site planning	Diarrhoeal diseases, acute respiratory infections
Clean water	Diarrhoeal diseases, typhoid fever, guinea worm
Good sanitation	Diarrhoeal diseases, vector-borne diseases, scabies
Adequate nutrition	Tuberculous, measles, acute respiratory infections
Vaccination	Measles, meningitis, yellow fever, Japanese encephalitis, diphtheria
Vector control	Malaria, leishmaniasis, plague, dengue, Japanese encephalitis, yellow fever, other viral haemorrhagic fevers
Personal protection (insecticide-treated nets)	Malaria, leishmaniasis
Personal hygiene	Louse-borne diseases: typhus, relapsing fever, trench fever
Health education	Sexually transmitted infections, HIV/AIDS, diarrhoeal diseases
Case-management	Cholera, stigellosis, tuberculosis, acute respiratory infections, malaria, dengue , haemorhagic fever, meningitis, typhus, relapsing fever

Table: **Diseases targeted by preventive measures**

Epidemiology

Diarrhoeal diseases

Diarrhoeal diseases are a major cause of morbidity and mortality in complex emergencies. These diseases mainly result from inadequate quality and quantity of water, substandard and insufficient sanitation facilities, overcrowding, poor hygiene, and scarcity of soap. In camp situations, diarrhoeal diseases have accounted for more than 40% of these deaths in the acute phase of an emergency, with over 80% of these deaths occurring in children aged under 2 years. Outbreak investigations have shown that common sources of infections include polluted water sources (by faecal contamination of surface water entering incompletely sealed wells), contamination of water during transport and storage (through contact with hands soiled by faeces), shared water containers and cooking pots, scarcity of soap, and contaminated foods.

After the influx of 800 000 Rwandan refugees into North Kivu, Democratic Republic of the Congo, in 1994, 85% of the 50 000 deaths that were recorded in the first month were caused by diarrhoeal diseases, of which 60% were a result of cholera and 40% were caused by shigella dysentery.[4] The most important cause was scarcity of water; the mean water allowance provided by agencies per person per day in the first week of the crisis was 200 mL.[5] 55 cholera epidemics were reported in Democratic Republic of the Congo between March, 2001 and October, 2002, with a total of 38 000 cases including 2129 deaths affecting 51 health zones in seven provinces, with a case fatality rate of 5·6% (range: 0–33·7%) (WHO Alert and Response, unpublished data). Effective cholera preparedness and control measures should keep case fatality rates below 1%. In a camp situation, in which outbreaks are more easily propagated, a cholera outbreak can last between 3 and 12 weeks;[6] in non-camp settings in Democratic Republic of the Congo, the median duration was 16 weeks (range: 3–59 weeks). In more stable settings, increased frequency of diarrhoeal disease was associated with increased crude and under-5 mortality rates in an investigation of 51 post-emergency camps in seven countries from 1998 to 2000.[7]

Acute respiratory infections

Acute respiratory infections also account for a large proportion of the morbidity and mortality burden in complex emergencies. Conditions such as overcrowding, indoor fires, and inadequate shelter and blankets, especially in cold climates, provide favourable conditions for respiratory droplet transmission. Acute respiratory infections likewise amplify the transmission risk for meningococcal disease through aerosol transmission of respiratory secretions during coughing and sneezing.

Acute respiratory infections caused 63% of the morbidity in Nicaraguan refugees in Costa Rica in 1989.[8] In 1993, 30% of the under-5 deaths in residents of Kabul, Afghanistan and 23% of those in displaced people were a result of acute respiratory infections.[9] Pneumonia together with malaria and diarrhoea caused 80% of deaths in Congolese refugee children in Tanzania in 1999.[10] Most data on acute respiratory infections in complex emergencies are limited to mortality; few studies have been done on morbidity rates and even fewer on the specific pathogens causing these infections.

Some interventions in complex emergencies such as vaccination for measles, diphtheria, and pertussis have the added value of reducing the risk of acute respiratory infections, as these vaccine-preventable diseases not only cause acute respiratory infections but also diminish host defences and increase vulnerability to secondary bacterial infections. Vitamin A supplementation during measles vaccination campaigns also acts as a protective factor for acute respiratory infections independently of measles.[11,12]

Measles

Epidemics of measles have been a major cause of mortality in camp settings. Measles accounted for 53%

and 42% of deaths in refugees in eastern Sudan and Somalia in 1985, respectively.[13] However, such epidemics were not reported as frequently in the 1990s compared with the 1980s[14] and this trend seems to be continuing. A major factor has been the heightened awareness of the importance of mass measles vaccination campaigns by international agencies and the rapid implementation of an expanded programme on immunisation vaccination programmes in post-emergency settings and camps.[7,15] Of major concern, however, are reports of large-scale epidemics in countries affected by complex emergencies. Of the 15 countries that reported a national measles vaccination coverage of less than 50% in 1999, at least seven were affected by complex emergencies.[16]

Widespread measles epidemics have been reported in Ethiopia,[17] Democratic Republic of the Congo (WHO Alert and Response, unpublished data), and Afghanistan.[18] In Afghanistan alone, before a national campaign, an estimated 30 000–35 000 deaths caused by measles were recorded annually.[19] The proportion of cases in children older than 5 years in such settings can be substantial. More than two-thirds of measles cases in southern Iraq occur in children 5 years and older as a result of absence of immunisation during the early 1990s after the first Gulf War. In fact, substantial mortality could occur in older children and adults, especially in remote rural settings in which populations might not have been exposed to natural measles virus infection and routine childhood immunisation does not happen.[17] In stable populations, the case fatality rates generally range from 1–5% during the acute phase of the illness.[20] Although epidemics can be well controlled in camps in both the acute and post-emergency phases, this might not be the case in general complex emergency settings, with reported case fatality rates as high as 33%.

Overcrowding is associated with the transmission of a higher infectious dose of measles virus resulting in more severe clinical disease.[21] The frequency of severe measles is also higher in malnourished children, with results from one study showing a dose-response relation between the degree of wasting and cumulative frequency of measles in the preceding 2 weeks.[17] In addition to its association with wasting, measles also rapidly depletes vitamin A stores resulting in eye disease such as xerophthalmia and blindness. Because of poor diversity in diet, vitamin A deficiency might already be common in countries affected by complex emergencies.

Malaria

At least 90% of the 1 million annual deaths from malaria worldwide occur in sub-Saharan Africa and about 30% of malaria deaths in Africa happen in countries affected by complex emergencies.[22] People moving from areas of low endemicity (including non-immune people) to hyperendemic areas are exposed to high malarial transmission. Conversely, movement from hyperendemic to lower endemic areas also heightens epidemic risk in the local communities, especially if there are favourable conditions for the mosquito vector such as stagnant water, flooding, and changes in environment and weather patterns.

Overcrowded conditions and temporary shelters, which increase bite frequency, also promote the transmission cycle. Inadequate access to health care services, which prevents early and appropriate treatment, protracts the time parasites remain in the blood. A massive malaria epidemic happened in Burundi between October, 2000 and March, 2001, affecting seven of 17 provinces; there were over 2·8 million cases in a country with a population of 7 million. A combination of population movement, long-term breakdown in control efforts since the war started in 1993, and high levels of *Plasmodium falciparum* resistance to chloroquine were suggested to be the cause.[23]

Interruption of vector control programmes might not only lead to epidemics but might also cause re-emergence of disease. In Afghanistan, malaria was almost eliminated with aggressive vector control programmes in the 1960s and 1970s, before civil unrest began in 1979. However, during the past 30 years the disease has returned, with over 12 of 21 million people now living in malaria-endemic areas and an estimated 2–3 million cases in 1999, mainly caused by *Plasmodium vivax*, but increasingly caused by *P falciparum*.[24]

Meningitis

Large outbreaks of meningococcal meningitis have been reported in complex emergencies. Serogroup A and C of *Neisseria meningitidis* are the main causes of epidemic meningococcal meningitis in most countries, although serogroup W135 is becoming increasingly prevalent in sub-Saharan Africa. Epidemics are happening beyond the traditional meningitis belt to include east, southern, and central Africa (eg, Burundi, Rwanda, and Tanzania from June to October, 2002). Dry season, dust storms, overcrowding, and high rates of acute respiratory infections also amplify the risk of epidemic meningococcal disease.

There were six epidemics of meningococcal meningitis in Democratic Republic of the Congo in the first half of 2002 alone, affecting six health zones in four provinces (WHO Alert and Response, unpublished data). An outbreak in February, 1994, in a Sudanese refugee camp in northern Uganda lasted for over 1 year, and was reported to have begun in the camp's reception centre.[25] A meningococcal outbreak in 2003 affected eight of 12 provinces in Rwanda, seven of 17 provinces in northeastern Burundi, and refugee camps in neighbouring Kibondo province, Tanzania.

Tuberculosis

Tuberculosis is becoming an important problem in complex emergencies. Population mobility and scarcity of access to health services and drugs interrupt tuberculosis control programmes, and transmission is increased as a result of overcrowding and malnutrition. Additionally, complex emergencies might encourage the development of chronic cases and multidrug resistance because of low case detection, high defaulter, and low cure rates, further heightening transmission.[26] Over 85% of refugees originate from, and stay within, countries with high tuberculosis burdens.[27]

Tuberculosis is also a leading cause of death in HIV-infected people. Co-infection with HIV increases the risk of a latent infection progressing to active tuberculosis from 10% to 60–80%.[28] HIV-infected people are also at greater risk of developing severe side-effects from tuberculosis drugs. Additionally, the combination of antiretrovirals and antituberculosis drugs might temporarily worsen the immune status as in the immune reconstitution inflammatory syndrome, and also lead to adverse drug interactions.[29] For example, rifampicin, an antituberculosis drug, induces liver enzymes to break down antiretrovirals, thereby reducing their levels in the blood and potentially leading to drug resistance.

HIV/AIDS

There is a large overlap between countries affected by complex emergencies and those with high HIV prevalance, especially in sub-Saharan Africa. Conflict and displacement could amplify the risk of contracting HIV through use of unsafe blood, poor universal precautions in health care facilities, absence of treatment of sexually transmitted infections, which facilitates HIV transmission, behavioural changes including risk-taking behaviour and contractual sex, scarcity of condoms, and sexual violence.[30] However, these issues should be weighed against the reduction in accessibility and mobility of populations affected by long-standing crises and the pre-conflict baseline HIV prevalence. For example, Sierra Leone, which experienced war from 1991 to 2002, has a low HIV infection rate compared with neighbouring countries.[31] Conversely, the conflict in Côte d'Ivoire, a country with a higher HIV prevalence than its neighbours, raised concern that displaced people might actually exacerbate the HIV situation in surrounding countries. A similar concern surrounds the repatriation of refugees living in Namibia and Zambia, countries with high HIV prevalence, to Angola, a country with low HIV prevalence despite more than two decades of civil war.[32]

Humanitarian agencies have only recently recognised the importance of HIV/AIDS in complex emergencies, believing it was mainly a development issue.[33] However, some of the early HIV/AIDS programmes in complex emergencies were undertaken in Sudanese refugees in Ethiopia in 1992,[34] and Rwandan refugees in Tanzania in 1994.[35] The Interagency Standing Reference Group on HIV/AIDS in Emergency Settings has revised the emergency guidelines and added a matrix of interventions to be undertaken during a complex emergency.[36,37]

Viral haemorrhagic fevers

Outbreaks of viral haemorrhagic fevers are becoming increasingly frequent in complex emergencies. This is partly attributable to better surveillance but also shows changes in human behaviour that potentiate the risk of viral introduction and amplification in human populations. The major viral haemorrhagic fever threats to human populations in complex emergency settings are Ebola haemorrhagic fever, yellow fever, Lassa fever, and Crimean-Congo haemorrhagic fever.[38] Although viral haemorrhagic fevers cause fewer cases and deaths in people in complex emergencies than other communicable diseases, their high case fatality rate and massive psychological effects in the affected communities can be devastating.

Trypanosomiasis and leishmaniasis

Democratic Republic of the Congo had a striking resurgence of trypanosomiasis or sleeping sickness as a direct consequence of conflict. In 1930, over 33 000 cases were recorded, falling to less than 1000 in 1959 after active case finding and treatment.[39] Conflict in the 1960s led to the collapse of the control programme, and, in 2001, the number of cases of trypanosomiasis was estimated to be 40 000 with a prevalence of over 70% in some villages (WHO Communicable Disease Control, Prevention Eradication, unpublished data).

A major outbreak of cutaneous leishmaniasis was reported for the first time in the North-West Frontier province of Pakistan in 1997 in an Afghan refugee camp established for 17 years; the outbreak was probably a result of cross-border movement of infected migrants from Kabul, as the Afghan capital was undergoing a similar outbreak at the time.[40] An epidemic of visceral leishmaniasis (kala azar) in western Upper Nile in Sudan was estimated to have caused 100 000 deaths between 1984 and 1994.[41]

Diseases targeted for eradication

Countries affected by complex emergencies present major challenges in the drive to achieve global eradication of diseases. Guinea-worm eradication has been very successful, with the 3·5 million cases of less than 20 years ago now reduced by 98%. 20 formerly endemic countries have eliminated the disease. However, southern Sudan, which had more than 50% of the world's cases in 1995, reported more than 78% of the world's cases in 2001, despite several interventions to stop transmission in the continuing conflict.[42]

Similarly, the WHO Polio Eradication Initiative is focusing on several west African countries, and Afghanistan and Pakistan, where progress has been hampered by conflict. Efforts to achieve eradication during conflict have led to the establishment of more effective immunisation and disease surveillance systems, and poliomyelitis transmission has been interrupted in complex emergency countries such as Cambodia, El Salvador, the Philippines, and Sri Lanka.[43]

Interventions

Prevention and control of communicable diseases, case management, and surveillance are three key components of humanitarian response that provide major opportunities to reduce suffering and death in war-affected populations. Prevention and control interventions exist for the major high mortality communicable diseases. These interventions need to be widely implemented but might need simplification and standardisation according to the context of the situation.

The combination of malnutrition and infection causes most of the preventable deaths in complex emergencies, especially in young children. Malnourished people have compromised immunity and are not only more likely to contract communicable diseases, but also suffer from more frequent, severe, and prolonged episodes of these diseases.

Prevention and control

Site planning and shelter

Site planning at the beginning of an emergency can reduce the frequency of diarrhoeal diseases, acute respiratory infections, measles, meningitis, tuberculosis, and vector-borne diseases. There should be adequate space within and between shelters, and sites should have ready access to water, fuel, and transport, have fertile soil, and be secure. Environmental care, solid waste management, and protection of food stores can prevent explosions in rodent populations and outbreaks of diseases such as tularaemia that took place in post-war Kosovo in 1999–2000[44] and the rise in reported Lassa fever cases in Sierra Leone in 2003. International guidelines for the ideal size of refugee camps are now accepted,[7,45] but refugees increasingly tend to live in the host population so planning can be difficult.[46–49]

Water and sanitation

Aggressive public health preventive measures should augment traditional food and medical relief efforts during a complex emergency. Provision of sufficient clean water (for which minimum agreed standards exist),[50] adequate sanitation for excreta disposal, and management of medical and other solid waste can reduce diarrhoeal disease, typhoid fever, vector-borne disease, and scabies. Public education and sensitisation on issues of water, latrine use, and hygiene are vital in any water and sanitation programme. During the 1991 Kurdish refugee crisis, despite prompt relief efforts and good health status of the population, high rates of malnutrition and mortality were recorded because sufficient preventive interventions were not implemented in a timely way.[51] The provision of appropriate and sufficient water containers,[50] cooking pots, and fuel early in the relief response can reduce the risk of cholera by ensuring that water storage is protected and that food is cooked. Chlorination of water is essential but supplementary home chlorination might be necessary if acceptable, as is provision of soap and sufficient fuel or firewood for cooking.[52] Even the presence of soap used mainly for bathing and washing clothes (200 g per person per month) without education regarding hand-washing was associated with 27% fewer episodes of diarrhoea.[53] A minimum of 250 g of soap should be available per person per month.[50] The combination of malnutrition and infection causes most of the preventable deaths in complex emergencies, particularly in young children. Malnourished individuals have compromised immunity and are not only more likely to contract communicable diseases, but also suffer from more frequent, severe, and prolonged episodes of these diseases. In complex emergencies, it is essential that the food needs of the population are satisfied through the provision of an adequate general ration, and in some situations, through selective feeding programmes.

Immunisation

The major vaccines used in emergency situations are against measles, meningococcal meningitis, poliomyelitis, and yellow fever. Measles immunisation should be implemented immediately in all complex emergency situations if vaccine coverage rates are less than 90% and should not await a single case. Measles campaigns are one of the most cost-effective interventions in public health.[54] Recommendations have concentrated on the need to extend the upper age limit of measles campaigns from 4 years to 12 or 14 years;[55] however, the upper age limit for vaccination should be decided after a thorough review of the epidemiology of measles in the particular setting, and vaccine availability and resources. Furthermore, because case fatality rates might be very common in children aged 6–9 months as protection from maternal antibody wanes, this group should also be included in campaigns. These children, however, need to be revaccinated when they reach 12 months of age. Additionally, unless vitamin A is being delivered through another mechanism—for example, as part of national immunisation days for poliomyelitis—its administration should always be combined with measles campaigns.

Immunisation is the only means of protecting against yellow fever and is the key intervention in an outbreak. Poliomyelitis is not a disease that kills during complex emergencies, but it is associated with poor water and sanitation. The fact that these conditions are common during complex emergencies impedes global plans for its eradication.

Vector control

Important diseases commonly spread by vectors are malaria, dengue, Japanese encephalitis, yellow fever, typhus, and trypanosomiasis. Examples of vector control interventions that have been implemented in complex emergencies include insecticide-treated nets, indoor residual spraying for malaria, and traps for tsetse flies that transmit trypanosomiasis.

The choice of intervention is not prescriptive and depends on effectiveness, feasibility, cost, and speed of supply. The type of shelter available, human behaviour (cultural practices, mobility), and vector behaviour (biting cycle, indoor or outdoor resting vectors) are key local factors in making a decision. Insecticide-treated nets are effective against mosquitoes if properly used by the target population and if the nets can be supported or hung. In malaria-endemic areas of Africa, insecticide-treated nets are the most effective intervention, especially in young children, substantially reducing mortality by up to 60% and morbidity by 45% in trials in The Gambia.[56–58]

Indoor residual spraying of insecticide is commonly used in chronic emergency situations and is appropriate for populations that live in more permanent housing structures and in which the vector rests indoors. The programme should treat all houses and, although effective in west and south Asia when sprayed at the beginning of the transmission season, insecticide spraying is less effective in southeast Asia and of restricted use in the highly endemic parts of Africa. In chronic complex emergencies, repeated application can become very expensive. Environmental control is generally difficult and ineffective in an emergency except on a local scale. Draining water around water tap stands, larviciding breeding sites if these are few in number, and draining ponds if these are not used for washing can all reduce vector breeding sites. Aerial spraying, scrub clearance, and outdoor spraying with residual insecticide are inappropriate interventions at any stage of an emergency.

Epidemic preparedness and response

Epidemic preparedness and the ability to detect and verify the existence of epidemics from the onset of a complex emergency are crucial for early containment of outbreaks and reduction in mortality. There are often delays in detection resulting from an absence of appropriate surveillance and communications infrastructure, staff with no technical knowledge, and insufficient resources to analyse, investigate, and respond adequately to alerts. These delays often occur when populations affected by conflicts are widely dispersed and living in an area with a collapsed public health infrastructure. Early warning necessitates a much broader notion of surveillance using rumours of epidemics generated from early warning networks, involving, for example, non-governmental organisations (both health and non-health) and community workers. This should be combined with the capacity to verify rumours and undertake field investigations to confirm outbreaks through simple descriptive epidemiology and targeted clinical sampling for laboratory diagnosis. Similarly, an effective outbreak response often needs the same networks to be the engine of the response. Planning for such events is vital and should be done with a broad set of partners and adequate provision made to ensure availability of drugs, vaccines, and other supplies such as personal protective equipment that might be needed.

Provisions for appropriate collection, processing, and transport of clinical specimens to designated laboratories, either in or outside the country, should be instituted. Laboratory services are often seen as a low priority in emergency situations and although syndromic diagnosis can be useful in screening because it is sensitive, it is not very disease-specific. Improvement of clinical skills and also the use of simple laboratory tests (malaria rapid diagnostic tests and smears, stool, and urine microscopy) can help to improve diagnosis and therefore management of the patient.

Infection control in health-care settings is a major issue as the scarcity of even the most basic precautions can drive epidemics that are spread easily. Diarrhoeal diseases such as cholera and viral haemorrhagic fevers like Ebola can be amplified in settings with poor infection control. Planning for case management in complex emergencies should address basic infection control such as universal precautions, injection safety, medical waste management, and the planning for and provision of safe and simple isolation facilities.

Specific health education messages can help prevent many diseases including diarrhoeal disease, sexually transmitted infections, and HIV/AIDS. Understanding of personal hygiene can help to prevent diarrhoeal disease, scabies, and louse-borne diseases such as typhus, and relapsing fever. Understanding of local practices and participation of the community is key in implementing these interventions. An investigation in a Malawian refugee camp that underwent repeated cholera outbreaks showed that an improved water bucket with cover and spout to prevent household contamination was more acceptable to the population, despite the existence of a less familiar but more cost-effective method of chlorinating water.[59]

Community education and mobilisation is particularly important for case management of sexually transmitted infections in terms of contact tracing, and for directly observed therapy for TB to ensure treatment completion. At the community level, one home visitor for every 500–1000 people and one traditional birth attendant for

2000 people can be used as a guide. Activities and interaction between refugees and local communities, and culturally appropriate interventions and education need to be considered in any health education programme for disease prevention and control.

Case management

A high standard of care and treatment interventions is crucial in reducing mortality from communicable diseases. Inadequate community outreach, underuse of oral rehydration treatment, a slow rate of rehydration, use of inappropriate intravenous fluids, and inadequate experience of health workers in management of severe cases were some of the factors causing high mortality rates during the 1994 cholera outbreak in Goma, Democratic Republic of the Congo. The highest reported case fatality rate for a single day was 48%.[60] Heightened provision of qualified or local health care workers or both has been associated with reduced crude mortality rates and under-5 mortality rates.[7]

The use of standard treatment protocols in health facilities with agreed upon first-line drugs is also crucial to ensure effective diagnosis and treatment. For acute respiratory infections, empirical treatment with antibiotics is commonly used in complex emergencies based on WHO and national protocols, individual non-governmental organisation guidelines, and occasionally integrated management of childhood illness guidelines. These guidelines need standardisation and adaptation for adults, especially adults with HIV/AIDS, as there are additional pathogens causing acute respiratory infections in these individuals, and the management of the pathogens needs to be more aggressive to prevent complications.

In malaria management, the first priority is the prevention of mortality through early diagnosis and effective treatment. However, increased resistance of *P falciparum* to older antimalarials such as chloroquine and sulfadoxine-pyrimethamine means these drugs have lost effectiveness in most countries. WHO recommends a change in protocol to artemesinin-based combination treatments in countries where resistance levels to older antimalarials have reached 15%; these treatments are recommended by WHO for vulnerable populations affected by complex emergencies because they are highly efficacious, safe, and offer good patient compliance. However, standards for intermittent preventive treatment for pregnant women in complex emergency situations need to be developed.

A simplified and efficient drug regimen is especially important in complex emergencies. Effective, short-course antibiotics need to be identified for pneumonia, shigella dysentery, and sexually transmitted infections, with appropriate education about compliance and treatment. A 3-day regimen of amoxicillin in treating childhood pneumonia is as effective as a 5-day course, which is commonly used in developing countries.[61] A single dose 2-day course of ciprofloxacin could be used for treatment of *Shigella dysenteriae* type 1 rather than the twice-daily 5-day course.[62] Although single-dose formulations are available for the treatment of sexually transmitted infections (azithromycin, ceftriaxone sodium, cefixime, ciprofloxacin), the cheaper but longer (7-day) regimens of doxycycline and erythromycin are commonly used.

Implementation of tuberculosis control programmes in complex emergencies is feasible using the WHO tuberculosis control strategy, Directly Observed Therapy, Short-course (DOTS). Guidelines for refugee camps exist and are being revised and expanded to cover complex emergencies.[27] Local community education and a reliable drug supply are essential in any tuberculosis control programme, as is convenient and acceptable dosing such as thrice-weekly combination treatment rather than daily administration. Use of outreach workers from each ethnic group is important for compliance, as is reducing the distance travelled to seek drugs. An income-generation component could be incorporated to encourage people to stay on the programme after resolution of conflict. In the past, tuberculosis programmes in displaced populations were discouraged as their high mobility made treatment completion difficult, and were judged temporary. However, many complex emergencies are chronic and successful tuberculosis programmes using directly observed therapy in displaced people have been reported in northern India,[63] in Cambodian refugees in Thailand,[64] and in Rwandan and Burundian refugees in Tanzania.[65]

The syndromic management of sexually transmitted infections, which is necessary because of poor diagnostic facilities, might further facilitate antibiotic resistance. Additionally, the high rate of asymptomatic gonococcal and chlamydial infection, particularly in women, not only causes complications, but also facilitates the transmission of HIV. A rapid diagnostic test to detect symptomless infection and allow targeted treatment is warranted. At this stage, most countries affected by complex emergencies, although not providing antiretroviral drugs, should at least provide treatment for opportunistic infections in people living with HIV/AIDS. However, as the drugs become more affordable and voluntary testing and counselling becomes more commonplace, antiretroviral treatment will become a component of humanitarian aid. There are closely similar considerations to tuberculosis treatment in such situations, such as compliance and drug resistance.

Surveillance and surveys

Appropriate and effective response to and management of complex emergencies need timely and accurate data obtained from health information systems.[66] Data are obtained to identify and plan for the initial and evolving needs of the affected population and subgroups, to detect epidemics and to prioritise interventions, and to investigate the quality, coverage, and effectiveness of response and programmes. Generally three types of data are obtained: (1) rapid health assessments, consisting of an initial overview of the immediate effect and needs; (2) surveys, defined as intermittent, focused assessments that gather population-based health data; and (3) surveillance, defined as the ongoing, systematic gathering, analysis, and interpretation of health data. Baseline information and trends over time are essential for interpretation.

The four main areas included in a health information system are: (1) mortality; (2) morbidity; (3) nutritional status; and (4) programme indicators. The magnitude of mortality is often used to determine the stage of an emergency, with a crude mortality rate of ⩾1 death per 10 000 people per day defining the acute emergency phase.[50,67] However, this arbitrary cutoff might not be appropriate in many circumstances (eg, in developed country crises) and thus a doubling of the baseline crude mortality rate is a more appropriate definition if the data are available.[68] Crude mortality rate and under-5 mortality rate are the most commonly reported mortality rates in complex emergencies; however, in developed countries undergoing conflict, other age-specific mortality rates, such as those in elderly people, might be as important.[69] During epidemics, attack rates and case fatality rates need to be calculated.

Research needs

New instruments for complex emergencies are needed, such as rapid diagnostics, insecticide-treated material (eg, blankets and plastic sheeting), new heat stable vaccines, improved geographic information systems and mapping, and improved surveillance and learning instruments (see panel).

Pre-emptive vaccination strategies with oral cholera vaccine are possible only in stable refugee settings, chronic complex emergencies, or in chronic situations with recurrent or seasonal outbreaks where populations are believed to be at risk of an epidemic within 6 months (and not during an ongoing outbreak). Two cholera 01 vaccines are available (a two-dose killed vaccine, and a one-dose live vaccine which is not recommended in African settings in view of the high HIV seroprevalence). Mass vaccination with the two-dose oral cholera vaccine was proved feasible in a refugee camp of 45 000 people in Uganda with 87% coverage after the second round.[70] However, there are many limitations to the use of the vaccines such as the high cost per dose, the chaotic nature of an acute phase of an emergency, restricted accessibility because of security and infrastructure, difficult logistics requiring cold chain and shipping, and the minimum 4–5 weeks needed to achieve protection. A cost-effectiveness analysis of strategies for cholera control showed that vaccination and pre-emptive treatment would become more cost-effective than treatment alone if the cost of vaccine, now over US$4, fell to less than $0·12 per dose.[71]

Simple, effective, and affordable methods are needed to treat and safely store non-piped, gathered household water. Point-of-use chlorination and storage in special plastic containers of gathered household water reduced diarrhoeal illness in consumers living in poor sanitation and hygiene conditions in different countries.[72] In Bolivia, monthly episodes of household diarrhoeal illness were 1·25 and 2·2 in intervention and control families, respectively, indicating that 43% of community diarrhoea was preventable by use of the intervention. In Bangladesh, mean episodes of childhood diarrhoea per 1000 days were 19·6 and 24·8 in intervention and control groups, respectively, indicating that about 24% of recorded diarrhoea was preventable by using the intervention. Chlorine disinfection and storage in an appropriate container substantially improved the microbiological quality of non-piped household drinking water and reduced community diarrhoeal disease. Widespread use of this simple treatment and storage system for non-piped domestic water has the potential to greatly reduce the global burden of waterborne diarrhoeal disease.

Insecticide-treated nets are very effective in preventing malaria, however, in complex emergency situations, not everyone is able to afford or obtain a net, and sleeping in tents and under plastic sheeting needs novel and more convenient means of protection. Treated plastic sheeting and bedding have been tested in complex emergencies in Asia and Africa and are a promising option. Permethrin-treated outer clothing worn in the evening or in bed is effective in South Asia but has not been tested in Africa. Insecticide-treated top-sheets, blankets, and cloth wraps (chaddars) in Islamic countries could be used as protection in complex emergency situations. A randomised controlled trial in an Afghan refugee camp in Pakistan of permethrin-treated chaddars used for sleeping and top-sheets showed the chance of a malaria episode

Panel: Areas where further research is needed include:

- Rapid field diagnostics
- Use of artemisinin derivatives for malaria, especially in pregnancy, and new antimalarials for intermittent preventive treatment in zones of *P falciparum* resistance to Fansidar
- New, short-course therapies for acute respiratory infections, tuberculosis, and typhoid fever
- Vaccines—heat-stability, pentavalent vaccines, rotavirus vaccine for infants
- Zinc supplementation (with oral rehydration solution)
- Survey methodologies for complex emergencies
- Mapping and instruments for calculating size of affected populations

was reduced by 64% in children under 10 years and by 38% in people under 20 years.[73] A community-based trial of impregnated bed sheets in Kenya suggest that permethrin-impregnated bed sheets might be protective against malaria in individuals over 5 years old. No protective effect was seen in under-5 year olds; however, the trial had few participants and was done during a malaria epidemic in 1997–98 after El Niño rains.[74]

Plastic sheeting of polyethylene tarpaulins has replaced canvas tents previously used in camp settings. Insecticide-sprayed or impregnated plastic tarpaulins have the potential to prevent malaria transmission and reduce the fly population and factory-impregnated tarpaulins are being field-tested in phase III trials. Outdoor testing of deltramethrin sprayed or factory-impregnated tarpaulins in a refugee camp in Pakistan resulted in 86%–100% mosquito mortality whereas non-treated tarpaulin produced only a 5% mosquito mortality.[75] Although they do not provide a physical barrier to mosquitoes and thus do not protect the individual directly, treated plastic sheeting, if used by most inhabitants, can potentially control malaria by killing high proportions of mosquitoes, thereby reducing their transmission capacity. Complex emergencies are increasingly being characterised by dwellings with a combination of mud, thatch, and plastic, and further investigation into present and new vector control methods are needed.

Some studies suggest that the effectiveness of measles vaccine might be poorer than expected in some warmer, rural settings.[76] More studies are urgently needed to formally document breakdown in vaccine supply and logistics and to develop a more thermostable measles vaccine for developing countries with poor cold chain infrastructure including complex emergencies.

Much of the high excess morbidity and mortality due to communicable diseases that occur in populations in complex emergencies is avoidable. Effective interventions are available but are often poorly implemented, especially in non-camp settings where large geographical areas or entire countries are affected. Available interventions need to be implemented in a more systematic and coordinated manner by governments, UN agencies, and non-governmental agencies. Additionally, further research is needed to adapt and simplify interventions as well as exploring new ones.

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