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Where health care has no access: the nomadic populations of sub-Saharan Africa

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Summary Nomadic and seminomadic pastoralists make optimal use of scarce water and pasture in the arid regions south of the Sahara desert, spreading from Mauretania in the west to Somalia in East Africa. We attempted to summarize the fragmentary evidence from the literature on the health status of these populations and to assess the best ways to provide them with modern health care. Infant mortality is higher among nomadic than among neighbouring settled populations, but childhood malnutrition is less frequent. Nomads often avoid exposure to infectious agents by moving away from epidemics such as measles. Trachoma is highly prevalent due to flies attracted by cattle. The high prevalence of tuberculosis is ascribed to the presence of cattle, crowded sleeping quarters and lack of health care; treatment compliance is generally poor. Guinea worm disease is common due to unsafe water sources. Helminth infections are relatively rare as people leave their waste behind when they move. Malaria is usually epidemic, leading to high mortality. Sexually transmitted diseases spread easily due to lack of treatment. Leishmaniasis and onchocerciasis are encountered; brucellosis occurs but most often goes undetected. Drought forces nomads to concentrate near water sources or even into relief camps, with often disastrous consequences for their health. Existing health care systems are in the hands of settled populations and rarely have access to nomads due to cultural, political and economic obstacles. A primary health care system based on nomadic community health workers is outlined and an example of a successful tuberculosis control project is described. Nomadic populations are open to modern health care on the condition that this is not an instrument to control them but something they can control themselves.

keywords Africa south of the Sahara, nomads, drought, morbidity, mortality, Primary Health care

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Introduction

It has been estimated that there are 50–100 million nomads and seminomads in the developing world (Omar 1992). Over 60% of these populations live in Africa. Pastoralists migrate periodically with their herds to maximally exploit scarce resources (pasture and water) which they need for their animals and themselves and which are dispersed in time and space. It seems likely that this seasonal movement is an important determinant of nomadic people's health. However, the patterns of the common diseases in those mobile and dispersed communities are not well known. Limited availability of demographic and medical data makes it difficult to specify changes in the health of nomads.

In Africa, nomads have the least access to any health services, and no satisfactory strategy has been devised to deliver proper health care to remote populations. Major causes of mortality and morbidity seem to be preventable infectious diseases. Despite the efforts of national governments and international organizations, health programmes for nomads have proved to be costly and sometimes ineffectual (Imperato 1975; Ailou 1992). We reviewed the literature to describe the relationships between mobility and health among nomadic people in sub-Saharan Africa and considered ways in which appropriate health care might be provided to them.

Background

About half of the African countries have (semi) nomadic populations. From Senegal in West Africa to Somalia in the

east, from Algeria in the north to the Kalahari desert in South Africa, nomadism is common; people migrate episodically or periodically with their herds of camels, goats, cattle and sheep. We restricted this study to the nomads of sub-Saharan Africa.

Nomads are generally classified as hunters, collectors and pastoralists. Hunters and collectors, such as Kalahari Bushmen and collectors in the equatorial rainforests, are very few in number. Pastoralists can be subdivided into transhumants, who migrate regularly between two grazing areas along well-defined routes which are adhered to each year (Prothero 1963; Imperato 1974) and pastoralists, whose economy is based purely on migration and livestock rearing. Although they migrate along conventional routes, they can move in different directions every year and within a given year; for example, in one dry season they may visit certain wells and during the next dry season other wells, or a river in another direction. The third group are seminomads, who practice some nonpastoral activities such as small-scale businesses and farming while retaining migration and livestock herding as their basic economy; part of the family moves with the animals, while elderly people and children usually remain in the villages.

Most of the land that nomads exploit is either desert like the Sahara, or semiarid like the Sahil and north-eastern Africa. There is a considerable variation of annual rainfall in these regions, and much variation between different localities in any given year. The annual rainfall is usually below 300 mm per year, and even less in the desert. During the hot season temperatures exceed 45 °C in the desert and reach around 38 °C in the Sahil and north-east Africa. To survive in such harsh climates, nomads move seasonally with their herds. During the wet season when superficial water and pasture are abundant, pastoralists disperse over large areas of land, while in the dry season they tend to concentrate around wells, rivers, lakes or manmade ponds.

In West Africa nomads may travel thousands of miles. For example the Fulani pastoralists may move from Senegal all the way to northern Nigeria. There are traditional tribal boundaries between the nomadic pastoral tribes in north-eastern Africa. Within the tribe there are also clan boundaries that are usually respected, unless there is a *force majeure* like drought or civil war. For example the Turkana in Kenya do not move into Boran or Rendille territory only tens of miles away from them within Kenya. But they do cross the border between Kenya and southern Sudan because part of Turkana land is in Sudan. Thus the clans in north-east Africa generally move in a radius of about 100–150 miles maximum. The international boundaries set by the colonialists, and the regional and district boundaries set by national governments have, to a certain extent, limited nomadic movement as well.

In nomad societies grazing land and water are common property, while animals count as individual possessions. Herds are their main source of food and capital investment. Therefore pastoralists aim to keep their livestock herds as large as possible to secure adequate milk and meat supplies even though droughts when many animals may be lost, and to gain influence and respect within their communities. Such attitudes to the growth of herds have been criticized by international organizations, since they lead to overgrazing and consequently desertification and soil erosion. Pastoralism has been characterized as being environmentally harmful, primitive and detrimental to the national economy (Hardin 1968; Lamprey 1983). The United States Agency for International Development (USAID) and the World Bank have encouraged private and commercial ranging over communal pasture land (Galaty 1992). By contrast, some range ecologists and economists have emphasized that pastoralism is efficient, low-cost, and in some cases the only feasible food production method in very arid environments (Coughenour *et al*. 1985; Homewood & Rodgers 1987). Certainly nomads are independent, self-sufficient and contribute to the national economies of their countries. In many African countries nomadic pastoralists are still the major producers of milk, meat and other animal products.

Health problems of nomads

Given their lifestyle, systematic surveillance data on the health status of nomads are practically nonexistent. Most information is based on specific, often small-scale studies each providing a small part of the overall picture (Imperato 1975). In general, nomadic and settled populations in rural Africa are subject to the same kinds of health problems but the frequency of occurrence of specific diseases may greatly differ between nomads and settlers. Nomads appear to be generally healthier than their settled neighbours, but have much less access to health care, safe drinking water and formal education.

Childhood mortality

The most comprehensive work on morbidity and mortality of pastoralists was compiled by Hill in Mali (Hill 1985). Diarrhoea, respiratory infections, malaria and measles were among the major causes of infant and child mortality. Comparing the mortality of Tuareg (Tamasheq and Bella) and Fulani pastoralists to Sonrai agriculturalists in the same area (Chabasse *et al*. 1985), the infant mortality rate was higher among the Tuareg and Fulani (Table 1). Similarly in East Africa, Brainard (1986) found that nomadic Turkana suffered substantially higher infant mortality than settled Turkana agriculturalists. In an isolated pastoral community in the highlands of northem Somalia, which is almost free

Table 1 Infant mortality rates of settled and nomadic populations (per 1000 live births) in Africa

Region	Country	Population	Reference	Nomadic pop	Settled pop
West Africa	Mali	Fulani	Chabasse (1985)	138	–
		Tamasheq	Chabasse (1985)	181	–
		Bella	Chabasse (1985)	213	–
East Africa	Kenya	Turkana	Brainard (1986)	196	133
	Ethiopia	Boran	Lindtjørn *et al*. (1993)	61	
		Elka	Lindtjørn (1993)	158	

Bella and Tamasheq are both Tuareg groups. Sonrai are settled agriculturalists.

from malaria, Selden (1986) found that about 69% of all deaths were due to diarrhea, pneumonia, and vaccine-preventable diseases while deaths related to birth problems were another main cause of under-five mortality (Figure 1). The authors attributed the difference to lack of health service provision among the nomads. In south-west Ethiopia, The settled Elka suffered higher infant and childhood mortality than the seminomadic Boran due to epidemics of meningitis and malaria which did not affect the nomadic community (Lindtjørn *et al*. 1993).

Maternal mortality

Mace and Sear (1996) estimated the maternal mortality rate (MMR) among the Gabbra pastoralists in Kenya at 599 per 100 000 births. This is a high figure, even though the MMR in African populations usually exceeds 100. Selden (1986) derived an estimate of 1270 from inadequate data collected in a nomadic population in Somalia, the main causes being postpartum haemorrhage and prolonged labour. High MMR have also been observed in settled populations (Mace & Sear 1996). Traditional birth attendants among the Fulani in Mali (Hilderbrand 1985) and in Sanaag district in Somalia (Selden 1986) provide support rather than intervention-orientated care. Identification of high-risk cases and referral to health centres is the exception rather than the rule.

Childhood morbidity

Hill (1985) reported that nomads were less affected by common infectious diseases such as pneumonia and diarrhoea than settled populations in rural Africa (Hill 1985). In contrast to this, the patterns of respiratory infections, diarrhoea and fever in children of settled and mobile communities of the Rendille in Kenya was highly similar (Nathan *et al*. 1996). In a study conducted among the Fulani in Seno-Mengo, Mali, Hilderbrand (1985) found that diarrhoea occurred throughout the year, with peaks in October/November and in March/April. Since these peaks correspond to the dry seasons, the association with water shortage is obvious.

Viral infections

These are less common among nomads. For example, Chabasse *et al*. (1985) reported that they encountered neither measles nor lameness as an indication of polio among nomads in Mali. In a serological survey on measles among the Tuareg nomads in Niger, 64.5% of under-fives were seronegative, as were 57.9% of the children under 10 years of age and about 15% of the adults (over 20-year-old) (Loutan & Paillard 1992). In a survey of Wodaabe nomads in west Africa, a history of measles was reported for only 3.9% of under-fives (Loutan & Paillard 1992). Nomads reported accurately the history of measles of their children with 83.8% sensitivity and 97.1% specificity (Loutan & Paillard 1992). Among Turkana nomads in Kenya, none of the under 20 year-olds in one isolated village had measles antibodies (Anderson & Mufson 1972). Clearly then, transmission of infectious diseases among nomads may at times be very low. The large proportion of nomads susceptible to infectious dis-

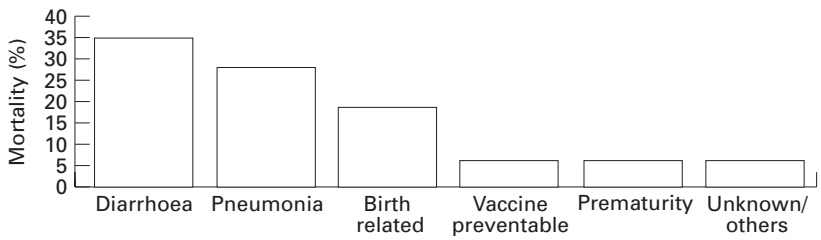

Figure 1 Percentage under-five mortality by cause in Ceel Mweyn, Somalia. (*Source:* Selden 1966).

eases increases the risk of outbreaks in their communities. This reservoir of susceptible populations might also jeopardize the efforts to control infectious diseases such as measles in neighbouring villages.

Nutrition

Nutrition for most African nomads is based on milk production complemented by grain obtained from trade or agro-pastoral production. The nutritional status of nomads is better than that of the settled agriculturalists in rural Africa, especially during the dry season. Among the children of settled and nomadic Rendille in Kenya, malnutrition was three times higher in the settled children (Nathan *et al*. 1996). Similarly, the percentage of children with severe and moderate malnutrition was four times less among seminomads and pastoralists than among settled populations in Somalia (Selden 1986). Vitamin deficiencies are rarely encountered during dry seasons, the most critical period for sahelian pastoralists (Loutan & Lamotte 1984). Hilderbrand found night blindness, probably due to vitamin A deficiency, among Fulani of Mali at the end of the dry season when milk production is lowest (Hilderbrand 1985). Iron deficiencies were reported among Kenyan Turkana and Somali nomads, especially among women and children (Murray *et al*. 1978; Murray *et al*. 1980a). Selden (1986) found that 40% of pregnant women in Sanaag, Somalia, had moderate to severe aneamia (Hb $<$ 8.7 g/dl).

Trachoma

Proximity to cattle, a high density of flies, an inadequate supply of water and the absence of latrines are part of nomad living conditions and favour the transmission of *Chlamydia trachomatis* (De Sole 1987), resulting in inflammation and scarring of the eyelids, eventually followed by entropion, trichiasis and blindness. A survey among 808 children aged 1–12 years in 8 villages of the seminomadic Karimojong of north-east Uganda revealed an overall prevalence of inflammation and scarring of 75% (Siegelaar, personal communication). Imperato (1974) mentions the high prevalence of trachoma among Tuareg and Maures in the Sahil but does not provide quantitative estimates.

Sexually transmitted diseases

Chabasse *et al*. (1985) compared the health status of pastoral and sedentary populations in Gourma in Mali, obtaining serological tests of Tuareg nomads, Fulani agro-pastoralists and Sonrai agriculturalists, and found an overall high prevalence of endemic syphilis. Seroprevalence rates ranged from 18% among the Sonrai to 55% in the Tuareg and 42% among the Fulani. These high rates are partly due to the inability of serological tests to distinguish venereal syphilis from endemic syphilis, which is caused by a variant of *T. pallidum*, is known to occur in arid climates and transmitted person-to-person through saliva and lesion-to-skin contact among both children and adults (Perine *et al*. 1984). The overall prevalence of *T. pallidum* infection among children under 10 years in the Mali study was 19%. Damiba *et al*. (1990) have shown that the northern region of Burkina Faso, which is inhabited by nomadic people, reported the highest incidence ($>$ 30 per 10 000 per year) of gonorrhea and urethritis in the country in 1983; this region is an area where both endemic and venereal syphilis are prevalent. By contrast, nomads in Niger were almost free from HIV infection in 1994 (Ousseini *et al*. 1995).

Tuberculosis

An unpublished study by WHO (quoted by Selden 1986) on the health of nomads in Afghanistan, Iran, Iraq, Somalia and Sudan stated that in 1972 tuberculosis was one of the major health problems among adult nomads. TB was noted as a problem among the Sahilian nomads in 1985: half of the 50 sputum samples collected from patients with suggestive symptoms such as cough and weakness were positive (Chabasse *et al*. 1985). In Kenya, the overall TB case detection rate in 1992 was 61 per 100 000 population but 176 per 100 000 in 13 districts with nomadic or seminomadic populations (van Cleeff *et al*. 1995). For new smear-positive cases these figures were 35/100 000 and 88/100,000, a ratio of 1–2.5. In absolute numbers the nomadic districts contributed 28% of all cases registered in Kenya in 1992 while making up only 11% of the total population. The high prevalence of tuberculosis among nomads is often attributed to the consumption of untreated milk. In Moroto district, Uganda, research has shown that most cases are not infected from cows (Dr Rossanigo, personal communication); crowded sleeping quarters are considered a more important cause there. Poor health care infrastructure in the areas where nomads live and poor compliance related to the mobile lifestyle of patients allow the infection to spread.

Malaria

Most of the areas where nomads live are not favourable habitats for mosquitoes. For example, in the central and northern regions of Somalia where more than 70% of the population are pastoralists, malaria is unstable and epidemics occur only in years with substantial rainfall (Warsame 1991). Similarly, the central and northern Ethiopian highlands, where pastoralists wander, are almost malaria-free or malaria is unstable (Kloos 1990). Nomads tend to avoid mosquito-infested areas during the wet season, like the Afar in Ethiopia, and

move to upcountry during the flooding times of the Awash valley (Kloos 1990). Consequently, nomads tend to have less immunity against malaria.

There are areas where nomads live in which malaria is endemic throughout the year, generally close to rivers. In Malian Gourma, falciparum malaria was found in up to 45% of the Fulani pastoralists and over 60% of Tuaregs. Transmission continued into the dry season, and the area was known to be hyperendemic for malaria (Chabasse *et al*. 1985). In southern Somalia, a serological study among nomads showed that 36.8% were seropositive for *Plasmodium falciparum* (Iliardi *et al*. 1987a).

Guinea worm

Almost all 15 countries which are endemic for dracunculiasis (CDC 1997; WHO 1997) have some nomadic or seminomadic populations. Dracunculiasis was reported during the wet season among the nomads of Mali and Niger (Chabasse *et al*. 1985). In one Local Government Area in Nigeria, it was endemic in 25% of the Fulani settlements, with an average of 3.8 active cases per settlement during the study period (Brieger *et al*. 1997). In Ethiopia, about 20% of Nyangaton (pastoralists) settlements surveyed were affected by Guinea worm (Jemaneh & Tatichef 1993). In a study conducted in Ayod, South Sudan, where the majority of the population are Nuer pastoralists, the point prevalence of dracunculiasis was 20.6%, with an estimated one-year period prevalence of about 60% (Guthmann *et al*. 1996). A similar study conducted in 27 villages in Kordofan, South Sudan, which has a large nomadic population, showed that the one-year period prevalence of Guinea worm was up to 65% (Cairncross & Tayeh 1988). Nomads mostly get their drinking water from ponds, stepwells and water holes excavated from the basin of dry streams, which is ideal for *Dracunculus* transmission (Macpherson 1981).

Leishmaniasis

Leishmaniasis is endemic in many countries of Sub-Saharan Africa in the dry, semiarid and savanna lowlands with acacia trees and termite hills where the sandflies live that act as vector. That is the type of ecology that nomads and seminomads frequently exploit. A study conducted in lower Omo, southern Ethiopia, among Nyangaton and Dassametch pastoralists showed leishmania skin test (LST) positivity rates from 55.9% to 85.5%. The seroprevalence rate was between 15.9% and 21.5% (Hailu *et al*. 1996). A serological study in southern Somalia showed that 9.7% of the nomads were seropositive for *Leishmania donovani* (Ilardi *et al*. 1987a). The Baringo district inhabited by Pokot and Tugen seminomads is reported to be among the highly endemic areas for leishmaniasis in Kenya, with LST rates up to 54% and seroprevalence rates of about 10% (Schaefer *et al*. 1994). There are also nomads living in the eastern and central states of Sudan, where leishmaniasis is known to be endemic (El-Hassan *et al*. 1995).

Onchocerciasis

The southerly movement of the nomads during the dry season to the savanna and rain forest areas exposes them to the bites of the vector *Simulium* and increases their risk of contracting onchocerciasis. The disease was encountered among the nomads in West Africa, with prevalences in Burkina Faso of 33.9 per 1000, Mali 5.03, Senegal 3.95 and Niger 0.33 (Imperato 1975). A study in north-west Nigeria showed that 37.2% of the Fulani in the savanna had contracted onchocerciasis. This high rate was attributed to the fact that Fulani pastoralists were exposed to the bites of *Simulium* during the prolonged period they spent daily in the bush grazing their animals (Edungbola *et al*. 1983). Similarly nomads moving to the savanna and into the rain forest are at risk of infections due to trypanosomiasis (Prothero 1977).

Intestinal parasites and helminths

These are less common among nomads than in settled populations. Although the use of latrines and conventional washing with soap and water are not common among traditional nomads, it would appear that their migratory life favours hygiene, as they move periodically away from accumulated dirt and rubbish (Omar 1992). Settled communities have higher rates of intestinal helminths and other parasites than nomads (Ilardi *et al*. 1987a, b). Table 2 shows the prevalence of some intestinal parasites of settled and nomadic communities in southern Somalia. The prevalence of hookworm and *Giardia lamblia* was very low among nomads and *Entamoeba histolytica* was not found at all (Ilardi *et al*. 1987a). Milk as staple diet may help to protect nomads against intestinal infections, in particular against *Entamoeba histolytica*, most likely thanks to the low iron content of milk and the competition of lactoferrin and transferrin (iron-binding proteins) in the milk with the amoebae for iron (Murray *et al*. 1980b). The low infection rates of intestinal parasites among nomads may also indicate that nomads have a greater awareness of hygiene issues than settled agriculturalists in rural Africa.

Brucellosis

Living in close contact with cattle exposes nomads to the risk of brucellosis. Cox reported from north-eastern Uganda that 27% of 139 patients with splenomegaly and 21% of 54 patients with musculoskeletal pains tested seropositive for

Table 2 Prevalence of parasites in stool samples from settled and nomadic populations in southern Somalia

Type of Parasite	Rates in nomadic pop (n = 62) (Ilardi *et al*. 1987a)	Rates in settled pop (n = 237) (Ilardi *et al*. 1987b)
Trichuris trichuris	1.6%	75.5%
Hookworms	1.6%	45.1%
Giardia lamblia	1.6%	25.7%
Entamoeba histolytica	0	19%
Ascaris lumbricoides	11.3%	19.4%
Strongyloides stercoralis	0	2.9%
Hymenolepis nana	0	1.3%

Brucella melitensis or *Brucella abortus* (Cox 1966). Given the nonspecific symptoms, this disease usually goes unrecognized and unreported.

Mobility and its effect on health

Mobility is an important determinant of health worldwide and nomadic populations in sub-Saharan Africa are no exception (Prothero 1977). The search for water and pasture are the main reasons given in the literature for nomadic migrations. There is a third reason which is never mentioned: nomads also migrate to avoid diseases both for themselves and their animals. When the Tuaregs in the Sahil hear about epidemics, e.g. measles, they tend to avoid certain wells and markets until the epidemic is over (Loutan & Paillard 1992). The Fulani in West Africa move southwards into the savanna, where water and forage are abundant but which is also infested with vectors such as the tsetse fly, only when they are forced to by drought (Prothero 1963). The pastoralists in northern Somalia do not move into valleys known to be infested with ticks and mosquitoes except when there is a long dry season (personal observation), while Afar pastoralists migrate to surrounding uplands to escape the mosquitoes during the inundation of the Awash floodplains (Kloos 1990). Thus the perceived health risks to humans and animals are an important element in decisions of when and where to move. Only during long dry seasons, when the risks of famine outweigh the risks due to vector-and waterborne diseases, do pastoralists move to an area which they would have avoided under normal circumstances.

Nomads can be active transmitters of disease to the communities into which they move. One of the major reasons why the world's last case of smallpox occurred in Somalia was continual movement of the nomads and their reintroduction of the disease into the settled populations. This last case concerned a resident of Merka town on the Indian Ocean who was infected by a 6-year-old nomad girl from Ogaden, Ethiopia (Fenner *et al*. 1988). Diseases that are thought to be under control can remain in inaccessible pockets of infection among nomads. During migration, they may transport the disease over great distances and across national boundaries. For example, the majority of Fulani settlements in Nigeria found infected with Guinea worm were not covered by routine surveillance. It was reported that some of the Fulani in those settlements had recently come from the Republic of Benin (Brieger *et al*. 1997). Another example is that the first Guinea worm cases reported from Kenya were among Turkana nomads; three of the cases probably contracted the disease in Sudan and imported it into Kenya (Macpherson 1981). Nouri and Mahdavi Rad (1993) found that the incidence of cryptosporidiosis in one town increased during the season when nomads moved close to the town and decreased when nomads moved away.

Nomads can also be passive acquirers of disease when they become exposed to various health hazards in the course of their movements. Pastoralists migrate to areas close to water sources (deep wells, river and lake shores), where villages and farms are usually located, during the dry season. There they come into contact with the settled populations and the breeding places of vectors. For example, in the dry season some Fulani in northem Nigeria move southwards into the valleys of the Niger and Benue rivers where the tsetse fly is present year-round, widespread during the wet season but more concentrated during dry months. The risk of man-vector and vector-animal contact increases since nomads and their stocks in their need of water are forced to seek out the areas where conditions are favourable for continued vector breeding during the dry season (Prothero 1963). At such times, pastoralists are at risk of contracting illnesses that are common among settled societies but against which they have no immunity, such as waterborne diseases (hepatitis and cholera), intestinal helminths and measles.

Effect of droughts on the health of nomads

Droughts threaten the livelihood of nomads, causing loss of their livestock and consequently large-scale famine. For the last two decades the frequency and intensity of droughts have

increased in Africa. The Sahilian countries (Mali, Niger and northem Nigeria) experienced a drought-induced famine in 1968–73 (Imperato 1975; Hill 1985; Kloos 1990; Nathan *et al*. 1996), while Somalia, Ethiopia and Sudan underwent a prolonged drought in 1971–72, in 1982–84 and in 1990–92, associated with civil unrest and wars (Kloos 1990; Hoog 1992; Prothero 1994). The environments which nomads inhabited were most vulnerable to the consequences of low rainfall. Pasture and water were reduced and pastoralists found themselves in increased competition with sedentary agriculturalists for greatly reduced resources. Encroachment on pastoral land by agriculturalists, expansion of national game parks and environmental degradation further complicated the situation of the nomads, reducing their pastoral use (Campbell 1984; Hoog 1992; Prothero 1994; Nathan *et al*. 1996). The synergetic effect of all these factors forced the pastoralists to seek assistance in the famine relief camps.

In famine relief camps nomads suffer from high mortality rates. Mortality patterns following famines and long-term displaced populations are complex and have recently been reviewed by Toole and Waldman (1990, 1988). Crude mortality rates (CMRs) from selected famines and refugee displacements show rates 20–30 times higher than the baseline. In eastern Sudan the CMRs of under-fives in one famine relief camp were 36 times higher than those of 5–14 year-olds during nonfamine periods (Toole & Waldman 1990). Most of this morbidity and mortality is due to an increased incidence of diseases already common among the poor communities such as measles, malaria, diarrhoeal diseases and acute respiratory infections, while classic epidemics of diseases such as cholera and typhoid are relatively uncommon (Henderson & Biellik 1981; Shears *et al*. 1987; Toole & Waldman 1988, 1990; Shears 1991). Since pastoralists live in isolation and are widely dispersed, the transmission of communicable diseases among them is often very low, and a large proportion of nomadic populations remain susceptible to diseases such as measles. In famine relief camps, susceptibility is increased through malnutrition while transmission rises through crowding, poor sanitation and movement of people between camps (Toole & Waldman 1988; Aaby *et al*. 1988; Kloos 1990; Prothero 1994).

Effect of resettlement schemes on health

The Ethiopian and Somali governments attempted to move drought affected nomadic pastoralists from famine relief camps and settle them forcibly in new permanent resettlement camps in agricultural areas. Some of the objectives of resettlement were to use fallow land for development, to respond to the effect of droughts on pastoralists and to integrate nomads into the social and economic development and modernization of the country (Kloos 1990; Tsui *et al*. 1991), without consideration of the health hazards that can arise from such population movement (Kloos 1990). Firstly, increased population density in settlements facilitates the transmission of density-dependent diseases such as malaria and schistosomiasis. Secondly, pathogenic organisms may be introduced by settlers from the area of their origin. Finally, the intrusion of people into previously unsettled areas may expose them to new disease hazards.

From April 1973 to June 1975, Somalia settled more than 100 000 drought victims from central and northern arid pastoral regions in 3 agricultural and 3 fishing settlements (Tsui *et al*. 1991). Other than social and economic problems associated with changes from mobile to sedentary life, there were effects on health. Previously dispersed populations were concentrated at greater densities with increased risks from communicable diseases. Malaria transmission occurred year-round and nomads from areas where malaria is unstable and epidemics occur only in years with substantial rainfall, suffered high mortality and morbidity. Those who survived malaria often returned to their normal habitats carrying the malaria parasite which, in the wet season, infects nonimmune relatives (Warsame 1991).

Ethiopia resettled around 600 000 famine victims from central and northern highlands into semitropical southern and western lowlands. Most settlers in the resettlement programme came from malaria-free highlands and unstable fringe areas in Shewa, Tigray and Wello which put them at high mortality and morbidity risk from malaria in the more humid and lower altitudes of western parts. Particularly high mortality rates were reported from settlements in Gambella, Awraja district (Kloos1990).

Afar pastoralists in at least four settlements in Awash valley had *S. haematobium* infection rates up to 54% (Haile-Meskal *et al*. 1985). *S. mansoni* infections were significantly higher in the settlers' areas of origin (Wello and Tigray), than in western and southern Ethiopia, where most resettlements are located. Later between 5% and 20% of the indigenous pastoralists became infected with *S. mansoni* (Kloos 1988, 1990). Settlers from northern and southern Ethiopian highlands were first exposed to onchocerciasis and trypanosomiasis in the western settlements of Illubabur and Keffa, where dense forest and countless streams support the vectors (Kloos 1990).

Obstacles to health service delivery

Nomads are often at a disadvantage for receiving health care. In Somalia, for example, the national health plan (1985–90) recognized that 90% of nomads were out of the reach of the national health services. In central regions where inhabitants are mostly pastoralists, there were 5000 inhabitants per hospital bed, while for the settled population in Benadir region this

ratio was 350 inhabitants/bed (Nat. Health Plan 1985–90). Disease control programmes often fail to reach migratory populations. Imperato (1974) describes how over a period of 50 years successive forms of health services failed to have an impact on the health of nomadic populations in francophone Africa. Even today, the Expanded Programme of Immunization (EPI), despite massive assistance from the international communities (technically and economically) for two decades (Dalhuijsen & Velema 1995), still does not have access to the nomadic communities of Africa. Dao and Brieger (1994) found that only 2% of Fulani preschool children had received full childhood immunization compared to an estimated 40% of all children in the same area. Another study among the settled and nomadic Rendille in Kenya revealed that all children over 12 months of age in Korr village had full immunization coverage, while among their nomadic counterparts immunization coverage was zero (Nathan *et al*. 1996). The absence of antibodies against measles in a large proportion of the nomadic populations mentioned above (Loutan & Lamotte 1984; Loutan & Paillard 1992) does not show us only that transmission of disease is very low among nomads but also that nomads were not exposed to vaccines. Despite the effort of international organizations and national governments, immunization coverage, a major indicator of health service delivery, shows that the current (conventional) health system has no access to nomads of sub-Saharan Africa and that they form a pool of susceptible populations where an outbreak of communicable disease can occur at any moment.

Similarly, the Guinea worm eradication campaign was very successful in reducing the number of endemic villages in the world from over 23 000 in 1992 (Hopkins *et al*. 1993) to about 9500 in 1996 (WHO 1997) and the number of reported cases from an estimated 3 million in 1986 (Hunter 1997) to about 152 000 in 1996 (WHO 1997). Despite this, the campaign was much less successful in reaching nomadic populations. 95% of the remaining cases of Guinea worm disease in Uganda in 1997 are generated by the two districts inhabited by semi-nomadic pastoralists (Henderson *et al*. 1988). In a study of Guinea worm among the Fulani in Nigeria, Brieger *et al*. found that 25% of their settlements had at least one confirmed guinea worm case during the study period, but that these were not reported in the surveillance records of the Guinea worm control programme in the area. The health staff was not even aware of this, and the Fulani elders stated that they never benefited from the local health or other social services (Brieger *et al*. 1997).

Health services are usually in the hands of settled populations which do not relate well to nomads. Tensions between pastoralists and agriculturalists have existed from the earliest times as signified by the biblical story of Cain and Abel. Farmers of all times have defended their crops against the destructive effects of passing herds of cattle. Many nomads used to obtain food, animals and slaves by raiding their farming neighbours and this is a cause of distrust and dislike (Imperato 1974). Settled people tend to look down on pastoralists as uneducated and primitive or 'wild'. In reality pastoralists have adapted their lifestyle to the harsh circumstances they live in and have all the skills necessary to survive there. For many governments, the fierce independence of nomads poses a problem as they are difficult to control and resist any attempts in this direction, sometimes violently. Cultural and political differences thus hamper the contact between nomads and health workers in curative as well as preventive and promotional work.

Besides cultural barriers, one obstacle to providing health services to the nomadic populations is the prohibitive cost. During smallpox eradication in Mali, mobile teams visited all nomadic camps, using wells as focal points; the cost per nomad immunized was 11 times higher than that for settled individuals due to increased fuel and staff time (Imperato 1974, 1975). Similarly, in Botswana the cost of mobile medical teams for nomads was 8 times more for the same degree of effective care provided at a dispensary (Selden 1986). In Niger, the results of using mobile teams for delivery of health services to the pastoralists were unsatisfactory and ineffectual (Ailou 1992). Efforts have been made to deliver immunization at markets on market days (Imperato 1969). This was manageable for smallpox eradication, but is unlikely to yield an effective coverage since many mothers and children do not attend the markets frequently.

What health care for nomads?

The general conclusions from the study of nomads by Chabasse *et al*. (1985) were that improvement of their health would depend on availability of more and better-quality water and on better access to health services. Opinions differ as to how health services to pastoralists may best be organized and delivered. In north-west Somalia, Bentley (1989) suggested that nomads will have to wait until all villages in the region are covered by the PI-IC services, so that nomads can reach services at all times of their movement cycle. In the Sahil, Imperato (1974) conducted mass campaigns through mobile units as a temporary measure until permanent services could be set up, emphasizing the need to dissociate health workers from government administrators.

Sani Ailou states: 'It is possible to organize primary health care (PHC) services for nomads. The services should be capable of mobility matching that of the community they serve. They should establish seasonal circuits in accordance with the local patterns of population movements. Integrated fixed and mobile activities should be carried out in each defined operational area' (Ailou 1992). Omar puts emphasis on setting up PHC programmes for nomadic populations,

especially in countries with limited resources and large nomadic communities (Omar 1992).

Community participation is crucial for PHC programmes. Imperato (1974, 1975) found that involving nomads in their health care was difficult. They were highly suspicious of anything connected to government, feared tax collectors, and avoided gathering in any numbers for the same reason. By contrast, Bentley suggests that simple outside contacts and regular provision of essential drugs and supplies can be sufficient to motivate communities to help themselves (Bentley 1989). In Somalia, perception and participation of the community in PHC programmes was better among the northern pastoralists than the southern agriculturalists (Dualeh 1987). In north-east Uganda, one Karimojong pastoralist community successfully manages its own clinic employing staff selected from their midst and using the proceeds to finance small-scale development activities (personal observation).

Nomadic community health workers

A logical consideration would be the recruitment and training of nomadic community health workers (CHWs) for nomadic settlements (Brieger *et al*. 1997). Since there are migrant schools serving the Fulani pastoralists in Nigeria (Dao & Brieger 1994), and shops (known as *kabadhe*) that sell cereals, sugar and other items to the nomads in northern Somalia (personal observation), it should also be possible to establish migrant health posts with nomadic CHWs. Such CHWs should be selected by and from nomads, and should move with them. Training and selection of nomadic CHWS would not differ from that of the CHWs among settled people and should be organized during the rainy season when nomads have lighter workload.

Expectations from nomadic CHWs should not differ from CHWs in villages. In north-west Somalia, CHWs among settled people could handle pneumonia and diarrhoea effectively (Dualeh 1987; Bentley 1989). Since respiratory infections, diarrhoea, malaria and measles are the major causes of infant and child mortality among nomads, nomadic CHWs can help in reducing infant and child mortality through early treatment of malaria and respiratory infections and through health education. Nomadic CHWs can preregister all children in their area eligible for vaccination and schedule immunization sessions in the nearest village with EPI teams in the area. Fear of government interference is less likely to occur if registration is in the hands of a person from the community itself. Nomadic CHWs who fulfil these roles are likely to reduce all-cause mortality among children as has been shown among settled populations (Velema *et al*. 1991). For adults, treating wounds is an important role; nomadic CHWs can identify and contain cases of Guinea worm disease; they can follow up TB and leprosy patients among nomads, and support STD control programmes; together with tribal leaders or health committees, CHWs can arrange early referral of serious cases to the nearest health facility.

Sustainable and regular delivery of supplies is a prerequisite. This could take place at strategic locations such as villages or wells known to nomadic CHWs and within easy walking distance. An alternative might be to allow the nomadic CHW to obtain specified drugs at any health unit in the district against agreed prices.

Modalities of supervision and monitoring of nomadic CHWs should be based on a well-structured plan of action devised on the migratory patterns of the community concerned. A regular reporting system should enable nomadic CHWS to have regular dialogue and consultation with the immediate second level of supervision. Nomadic CHWs could also send their activity reports to predetermined specific points at regular intervals, mainly through tribal chiefs, village CHWs, extension workers or animal husbandry units. There could also be an indirect supervision entrusted to the community tribal elders who might be asked to report on the activities of their CHW and provide progress reports in a formalized manner. For example they could check for unnecessary travelling, the number of home visits per day, misuse of supplies, registration of births, deaths, and registration of children for immunization. Periodic and personal medical supervision by a qualified health worker remains vital, however.

Community support of the CHW may be either in kind, like a number of goats every season, watering his animals or farm when he is at work, or in cash either monthly or seasonally. Support may be easy in good times but in times of drought and hardship it may be very difficult as described by Snell (1996) and Cole (1988). It is vital for the acceptance of nomadic CHWs that they are not perceived as government workers but as full members of the community who respect traditional patterns of authority (Imperato 1974). Furthermore, the feasibility of working with nomadic CHWs will likely depend on the distances covered by a nomadic population and the ease with which health units serving settled populations can be used to support nomadic counterparts. In Somalia, for example, nomads and villagers usually belong to the same ethnic group whereas in Nigeria, Fulani and the settled Yoruba hardly communicate with each other and even less on the subject of health care (Dao & Brieger 1994). A special difficulty presents itself where nomads cross international borders and cannot rely on support from the health service of either country; to make things worse, these services are often organized quite differently.

The above discussion of the concept of nomadic CHWs is intended to draw attention to this possible approach. Clearly, many local circumstances need to be taken into account in

the design of such a programme, including the political will to provide sustained and effective support. A logical next step in this context is to think of ways of integrating this concept of health care for humans with a similar approach to animal health (Sollod & Stem 1991). Given the high value attached to animal health by nomads, acceptance may be better if CHWs can serve the health of both people and animals. Although there are dangers to this, particularly in the area of confusing doses and drugs, experiments with this approach appear to have been undertaken in Uganda and Chad among others but to our knowledge no reports have been published.

Tuberculosis control

Direct observation of TB patients while under treatment is a difficult task, compounded by the mobility of nomads, which makes tracing the defaulters almost impossible (van Cleeff *et al*. 1995). In Moroto district, Uganda, inhabited almost entirely by seminomadic populations, only 55% of all 232 sputum-positive TB patients who started treatment in 1994 were cured. Of the 215 cases who started treatment in 1995, only 42% were cured (Dr Rossanigo, personal communication). Staff at the Morulem TB hospital in Kotido district, Uganda, where both nomadic and settled patients come for treatment, testified that nomadic patients will only come for treatment when they can no longer walk and often do not complete the course once they are discharged after two months and out of reach of field workers for follow-up. In Somalia, the strategy found most effective to encourage compliance was having the patients swear on the Koran that they would comply (Snell 1996). Others tried to ask the patient to bring a guarantor to vouch that the patient would comply and take the drugs as agreed (Crowe 1997).

In Kenya, national surveys in 1964 and 1974 yielded cure rates of 60–70% on standard treatment against 30% in nomadic districts (van Cleeff *et al*. 1995). Short-course chemotherapy under direct observation reduced the defaulting rate among nomads from 1979 onwards (Aluoch 1979). The *Manyatta* project was started in 1992. *Manyatta* signifies a village created with locally designed, relatively cheap houses, where patients can stay and get food. This permitted staff to observe directly that patients ingested the drugs until they were smear-negative, usually after four months. The achievements of *Manyatta* were very good, with high cure rates of 80–88% and low defaulting rates of 5% (van Cleeff *et al*. 1995). The WHO's recommended strategy of controlling tuberculosis (DOTS) (WHO 1993) is therefore effective even among the nomads. This approach is much cheaper than hospitalization of TB patients.

The *Manyatta* project proves that nomads do not resist modern medical care; instead they will stick to any health project if their perceived priorities are met (van Cleef *et al*. 1995). Implementing such a project in countries with large nomadic populations, like Somalia and Ethiopia, may be costly. Most probably, community-based DOTS would be more appropriate in nomadic settings. A study on community-based DOTS carried out in Hlabisa, South Africa, shows that CHWs and voluntary lay persons could do the supervision of DOTS effectively. It was found that case-holding rates were higher with CHWs (88%), and voluntary lay persons (85%) than with health workers (79%) (Wilkinson & Davis 1997). Community-based DOTS was also found to be cost-effective in South Africa (Wilkinson *et al*. 1997).

Conclusion

A general conclusion from this review is that important inequalities in health exist between nomadic and settled populations. Some of these health problems are due to the particular environment in which nomads live –, e.g. tuberculosis, trachoma, guinea worm disease. To a large extent, however, these inequalities are directly or indirectly related to an absence of modern health care among nomadic populations. It can be stated that whatever health services are available in the remote areas where nomads live, these have no access to the nomads themselves.

Clearly, nomadic people are aware of the health problems they encounter. They have understood that disease can be avoided by moving away and avoiding exposure. This is one of the traditional coping mechanisms they have developed. This tactic turns against them when they do come into contact with settled populations, because they are more susceptible as a group. This occurs, for example, when drought forces nomads to concentrate near water sources or even to enter famine relief camps.

It has been suggested that, due to unfamiliarity, nomadic populations are not interested in modern health care, but this attitude seems to be changing. This is, among others, suggested by the success of the *Manyatta* project and by recent personal observations in Kenya and Uganda, where pastoralists are more likely than before to go to a clinic or hospital if someone falls ill and will even sell a cow to cover the expense.

An important condition for the success of health care to nomads is that it should avoid all appearance of being a vehicle for government interference. There is evidence that community participation is a real possibility on the condition that people can truly take charge of their own health care.

Mobile health teams often are too costly and inefficient. The creation of regular points of contact along the migration routes, where nomadic CHWs can obtain supplies and advice and refer complicated cases, is likely to be more affordable and sustainable in the long run.

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