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The use of traditional medicinal plants as antimicrobial treatments

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INTRODUCTION

The scourge of microbial infections

Microbial infections are a major cause of morbidity and sometimes mortality, especially in developing countries such as Namibia. Severe poverty is the root cause of this undesirable situation as it leads to malnutrition, inadequate sanitation and consumption of unclean food and drink. This, compounded by lack of education and access to primary healthcare, results in infections by microorganisms such as viruses, bacteria, fungi and protozoa (Table 4.1).

The most vulnerable to infectious diseases caused by microbial agents are children under the age of five, where 66% of deaths in this age group are a result of such diseases; 34% of all deaths are attributed to infectious diseases. This was underscored by WHO's (World Health Organization's) Regional Director for Africa, Luis Gomes Sambo, in 2011 when he said 63% of deaths on the continent were caused by microbial infections, with HIV/AIDS accounting for 38.5% of these (Anon, 2012). Thus, the most vulnerable groups are young children and individuals whose immune systems are compromised by HIV infection (Table 4.2).

Community-acquired bacteraemia is a major cause of death in children at rural sub-Saharan district hospitals. A study by Berkley et al. (2005) showed that 12.8% of infants younger than 60 days had bacteraemia. *Escherichia coli* and group b streptococcus were the predominant infectious agents. In those older than 60 days, 5.9% were infected with *Streptococcus pneumoniae*, *Salmonella* species, *Haemophilus influenzae* or *E. coli*. In Gambia, children under five years have a 2.5% risk of

TABLE 4.1: Numbers of deaths by different causes in the developing world.

	Number of deaths (in thousands) per age group					Total
	5–14	15–44	45–59	60+	All ages	
Infections						
Respiratory	2,710	244	139	78	813	3,984
Diarrhoeal	2,474	210	97	30	54	2,865
Tuberculosis	71	151	696	534	526	1,978
Malaria	632	153	109	22	12	928
Tetanus	450	28	10	8	8	504
Pertussis	277	44	–	–	–	321
HIV	56	10	162	14	6	248
Meningitis	130	60	28	7	8	233
Syphilis	77	–	103	10	–	190
Other	434	226	180	94	94	1,028
Sub-total	7,311	1,126	1,524	797	1,521	12,279
Other causes						
Perinatal	2,402	–	–	–	–	2,402
Congenital	503	42	43	5	–	588
Pregnancy-related	–	12	408	7	–	427
Injury	487	407	1,683	381	462	3,420
Cancer	43	64	411	967	2,211	3,696
Cardiovascular	122	80	540	1,368	6,908	9,018
Chronic respiratory	156	50	90	222	1,818	2,336
Other	556	296	674	709	1,676	3,911
Sub-total	4,269	951	3,849	3,659	13,075	25,799
Total	11,580	2,077	5,373	4,456	14,596	38,078

Adapted from Hesketh and Zhu (1997).

TABLE 4.2: Estimates of mortality in children under five in sub-Saharan Africa.

Cause of death	Africa (%)	Global (%)
Acute respiratory infection	16	18
Diarrhoeal disease	14	15
Malaria	22	10
Measles	8	5
HIV or AIDS	8	4
Neonatal	13	23
Other	19	25
Total	100%	100%
	4.5 million people	10.9 million people

Adapted from Mulholland and Adegbola (2005).

acquiring an invasive bacterial infection with 28% of those dying from bacteraemia when admitted. Malaria is one of the major infectious diseases, globally, together with tuberculosis and HIV/AIDS (Coppi, Cabinian, Mirelman, & Sinnis, 2006). Of an estimated 225 million cases, globally, malaria caused 781,000 deaths in 2009 (Ku et al., 2011; USAID, 2011). Every year, 90% of malaria cases occur in sub-Saharan African countries (Mohammed, 2009), causing a mortality rate of over one million people, mainly children under the age of five years and pregnant women (Rosenthal, 2003; Ogunlana, Ogunlana, & Ademowo, 2009; Ku et al., 2011). Eight per cent of paediatric hospital admissions in Mozambique had bacterial infections, with *Salmonella* and *Pneumococcus* being isolated in 26% and 25% of all cases, respectively (Sigauque et al., 2009). Case-fatality from bacteraemia was 12% and accounted for 21% of hospital deaths; in addition, resistance to commonly used antibiotics was high in isolated *Salmonella*, *H. influenzae*, and *E. coli* (Sigauque et al., 2009). Bacterial meningitis is also a major global threat; a study in Gambia estimated that 2% of all children die of the disease before they reach the age of two (Adjogble et al., 2007).

Most microbial infections are treatable and are preventable. Yet they continue to be a public health concern, particularly food-borne diarrhoeal diseases and respiratory infections, which are life-threatening. Others are a cause of morbidity reducing the quality of life, such as periodontal diseases and other communicable opportunistic infections, especially in immune-compromised individuals; emerging diseases also contribute to morbidity rates (Azevedo, Prater, & Hayes, 2010). A lack of resources limits the availability of adequate sanitation, clean food and water, immunization, healthcare and medicines. As part of achieving Vision 2030, Namibia seeks to reduce morbidity and mortality of all preventable diseases.

A review of 22 studies conducted in Africa involving 58,296 patients revealed that 13.5% of adults and 8.2% of children had blood infections. Seventy per cent had malaria but, of the rest, more than half had *Salmonella* infections followed by *Staphylococcus aureus* then *E. coli* (Reddy, Shaw, & Crump, 2010). Food-borne pathogens are a major cause of concern in all parts of the world; there are 31 different pathogens known to cause food-borne illnesses (CDC, 2011). *Salmonella* spp., *S. aureus* and *E. coli* O157:H7 are generally the top five agents responsible for the majority of food-borne illnesses, hospitalizations and deaths (CDC, 2011). *Staphylococcus aureus* are gram-positive bacteria that can be found in the soil, on the skin or mucous membranes of humans, and on the bodies of animals (van Huyssteen, 2008). It causes skin infections under moist conditions or when diseases, surgical wounds or intravenous devices have breached the skin. Ninety per cent of all osteomyelitis and septic arthritis cases are of staphylococcal origin. *Staphylococcus aureus* also causes diarrhoea, pneumonia and destructive endocarditis (Gillespie & Bamford, 2007). *Escherichia coli* is the predominant gram-negative organism living in the intestines of humans and animals and is known to cause diarrhoea and urinary

tract infections. Cholera is a major food-borne infection with Africa contributing more than 80% of cholera cases worldwide (Naidoo & Patric, 2002).

Over 750 species of microorganisms inhabit the oral cavity, including *Candida albicans*, and *Niesseria*, *Lactobacillus* and *Staphylococcus* spp. (Avila, Ojcius, & Yilmaz, 2009). Whilst not all are harmful, conditions in the oral cavity such as poor dental hygiene and age can cause biofilms to form, which may contain pathogens that cause dental problems. Periodontal diseases and dental caries are two common dental problems caused by microorganisms; up to 90% of school children have a prevalence of dental caries and the majority of adults are also affected (Palombo, 2011). *Candida*, *Cryptococcus* and *Tinea versicolor* are chronic fungal infections often acquired by immune-compromised patients. *Candida* forms part of the normal microflora of the skin, gastrointestinal tract and female genital tract, however, the overgrowth of *Candida* leads to thrush and vaginitis. Protozoan diseases are caused by plasmodia, *Leishmania* and *Trypanosoma*, with the most prevalent being malaria caused by *Plasmodium* spp.

Common microbial infections in Namibia

HIV/AIDS is the underlying cause of death due to microbial infections; others include tuberculosis, and diarrhoeal diseases that are typically caused by *Salmonella* and *Streptococcus* spp. (Table 4.3). Malaria and lower respiratory tract infections are also important. Malaria, which was the cause of most febrile illnesses in 2005, has declined by over 97% in Namibia with 62.2 cases per 1000 people and 9.6 deaths per 1000 being reported in 2009 (MoHSS, 2010). Most febrile cases are now a result of microbial infections, especially pneumonia and septicaemia (L. Haidula, National Case Manager, National Vector-Borne Disease Control Programme, MoHSS, personal communication, October 2011).

TABLE 4.3: Top ten causes of deaths in Namibia.

Cause	%
HIV/AIDS	51
Perinatal conditions	4
Cerebrovascular disease	4
Tuberculosis	4
Ischaemic heart disease	4
Diarrhoeal disease	3
Malaria	3
Violence	2
Lower respiratory tract infections	2
Road traffic accidents	2

Source: WHO (2003)