



# YOUNG PEOPLE AND POVERTY-RELATED AND NEGLECTED DISEASES

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## ACKNOWLEDGEMENTS

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## ABOUT DSW

**Deutsche Stiftung Weltbevölkerung (DSW)** is a global development organisation that focuses on the needs and potential of the largest youth generation in history. We are committed to creating demand for and access to health information, services, supplies, and economic empowerment for youth. We achieve this by engaging in advocacy, capacity development, and reproductive health initiatives, so that young people are empowered to lead healthy and self-determined lives. With our headquarters in Hannover, Germany, DSW operates two liaison offices in Berlin and Brussels, as well as maintaining a strong presence in Ethiopia, Kenya, Tanzania, and Uganda. DSW also advocates for investment in research and innovation to fight poverty-related and neglected tropical diseases – diseases that continue to disproportionately affect women and girls.

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*Yves Lafort. Young people and poverty-related and neglected diseases. Brussels, November 2017.*

*DSW, Brussels, November 2017*

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# YOUNG PEOPLE AND POVERTY-RELATED AND NEGLECTED DISEASES

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## ACRONYMS

<b>AIDS</b>	Acquired Immuno-deficiency Syndrome
<b>BCG</b>	Bacillus Calmette-Guérin
<b>DALY</b>	Disability-adjusted life years
<b>GBD</b>	Global Burden of Disease project
<b>HIV</b>	Human Immunodeficiency Virus
<b>HPV</b>	Human Papilloma Virus
<b>IPT</b>	Intermittent preventive treatment
<b>LLIN</b>	long-lasting insecticidal nets
<b>LMICs</b>	Low- and middle-income countries
<b>MDA</b>	Mass drug administration
<b>NGOs</b>	Non-governmental organisations
<b>NTDs</b>	Neglected Tropical Diseases
<b>(P)MTCT</b>	(Prevention of) maternal-to-child transmission
<b>PRNDs</b>	Poverty- Related and Neglected Diseases
<b>R&amp;D</b>	Research & Development
<b>SRH</b>	Sexual and Reproductive Health
<b>STI</b>	Sexually transmitted infections
<b>TB</b>	Tuberculosis
<b>UNAIDS</b>	The Joint United Nations Programme on HIV/AIDS
<b>WASH</b>	Water, sanitation and hygiene
<b>WHO-TDR</b>	Special Programme for Research and Training in Tropical Diseases
<b>WHO</b>	World Health Organization



# INTRODUCTION

Adolescence and youth\* is often thought to be the healthiest time of life. Yet, more than half of the world's 1.8 billion young people aged 10–24 years grow up in 'multi-burden countries', characterised by high levels of adverse health outcomes. While a rapid decrease in morbidity and mortality in young children (0-5 years) has been achieved, this has not been matched by similar improvements in the health of 10–24 year olds.<sup>1</sup> Furthermore, the age span between 10 and 24 years is a critical period in a person's development during which many risk or protective behaviours begin or are consolidated.<sup>2</sup>

Young people's health, and in particular adolescents' health, has been receiving increasing attention in the last decade. A major report of the Lancet Commission on adolescent health and well-being was launched in 2016, alongside an extensive international analysis of findings related to young people's health from the Global Burden of Disease (GBD) project led by the Institute for Health Metrics and Evaluation<sup>3,4</sup> The United Nations made adolescent health and development an integral part of the Global Strategy for Women's, Children's and Adolescents' Health (2016–2030),<sup>5</sup> and the World Health Organization (WHO) developed guidelines for Global Accelerated Action for the Health of Adolescents.<sup>2</sup>

According to the GBD, injuries, mental health conditions, common infectious diseases, and sexual and reproductive health (SRH) problems are the dominant health problems for young people. Infectious diseases that are mostly confined to a tropical environment and therefore predominantly occur in resource-limited countries, as well as other poverty-related diseases, have been long neglected both in research and disease control. In the wake of the resource mobilisation for the control of the HIV pandemic, more attention has been given in the past years to these Poverty-Related and Neglected Diseases (PRNDs). The WHO developed a roadmap for implementation to overcome the global impact of neglected tropical diseases (NTDs) for the period 2012-2020,<sup>6</sup> and the Special Programme for Research and Training in Tropical Diseases (TDR), hosted by WHO, developed a research strategy for 2018-2023.<sup>7</sup>

It is well-established that PRNDs mainly affect neglected populations, the marginalised and vulnerable, and disproportionately affect women and children. The links between PRNDs and young people's health and wellbeing are, however, less well-understood.<sup>8,9</sup> **This study assesses what impact PRNDs have on young people, what conclusions can be drawn from this for PRND research and development (R&D) needs, and what role adolescent- and youth-focused approaches can play in fighting PRNDs. The report addresses these questions globally, as well as focusing on four countries in eastern Africa (Ethiopia, Kenya, Tanzania, and Uganda).**

\* While there are no universally accepted definitions of "adolescence" and "youth", this report will follow the United Nations definition of adolescents to include persons aged 10-19 years, and youth as those between 15 - 24, and refer to both groups together as "young people", encompassing the ages of 10-24 years.<sup>304</sup>



# DEFINITIONS

## AGE GROUPS

In the framework of this report, the following defined age groups were identified:

- Adolescents: 10 – 19 year olds
- Youth: 15 – 24 year olds
- Young people: 10 – 24 year olds
- Adults: 15 years or older
- Children: younger than 15 years

## POVERTY-RELATED AND NEGLECTED DISEASES

We included 33 PRNDs in this assessment: all 21 diseases classified by the WHO as NTD, and an additional 12 poverty-related diseases that are included in the Global Funding of Innovation for Neglected Diseases (G-FINDER) survey.<sup>10</sup>

The diseases are listed and described in Annex 1.



# METHODOLOGY

We extracted from the **GBD database, age-specific incidence, prevalence and death rates** of each of the 33 selected PRNDs. We complemented this analysis with a systematic literature review with the search terms ‘adolescent’, ‘youth’ or ‘young people’, and disease-specific search terms (Annex 1), and with a review of relevant international documents on the different PRNDs.

Based on the above, we classified the diseases in **three categories: (1) diseases that have the highest burden in the 10-24 years age category, (2) diseases that have the highest burden in pre-adolescence childhood (0-10 years) and a gradually decreasing burden during adolescence and adulthood, and (3) diseases that have the highest burden in adulthood.** To assess the burden of PRNDs in young people in eastern Africa, we more profoundly reviewed papers and documents from Ethiopia, Uganda, Kenya and Tanzania.

We conducted a second systematic literature and document review to identify papers and documents describing possible strategies targeting young people in the control of PRNDs. We assessed, firstly, to what extent current international PRND strategies and guidelines address young people, and secondly, to what extent current strategies and guidelines on adolescent/young people’s health address PRNDs, and identified relevant examples of interventions. We did this globally, and specifically for the four eastern African countries.



## FINDINGS

### BURDEN OF POVERTY-RELATED AND NEGLECTED DISEASES IN YOUNG PEOPLE

#### Group 1: PRNDs with the largest burden in young people

Diseases of which the incidence is still relatively low in childhood but gradually increases during adolescence, mainly due to changes in behaviour. Incidence typically peaks during adolescence and youth and then slowly reduces during adulthood. The graphs presenting the age-specific incidence and prevalence, by 5 years age groups, are available in Annex 2.

#### PRNDs with highest burden in young people

- HIV/AIDS
- Tuberculosis
- Schistosomiasis
- Soil-transmitted helminthiasis
- Strongyloidiasis
- Dengue
- Sleeping sickness
- Bacterial meningitis
- Guinea-worm disease
- River-blindness

#### HIV & AIDS

As young people become sexually active, they become vulnerable to HIV and other sexually transmitted infections (STIs). Incidence therefore rapidly increases in the 15-20 years age group, and peaks during the next 15 years before then declining.<sup>11</sup> In sub-Saharan Africa, this is even more outspoken in adolescent girls and young women.<sup>12,13,14,15</sup> In 2015 they accounted for 25% of new HIV infections among adults in this region.<sup>11</sup> They are therefore recognised by the Joint United Nations Programme on HIV/AIDS (UNAIDS) as a particularly vulnerable population.<sup>16</sup> In addition, the children that got infected through maternal-to-child transmission (MTCT) in the era before the prevention of MTCT was widely available, are currently moving into adolescence, increasing the number of people with HIV in that age group<sup>17,18</sup> and posing challenges, such as poor retention in care and treatment adherence.<sup>19,20</sup> Of particular concern are the low awareness of young people of their HIV status and the relatively higher mortality in this age group compared to other age groups.<sup>21</sup> AIDS is one of the main causes of death among adolescents globally, and particularly in Africa.<sup>22</sup> The latest estimates from 2015 rank AIDS as the eighth leading cause of





death among adolescents globally, and the fourth cause in African low- and middle-income countries (LMICs).<sup>2</sup> Adolescents are the only age group where AIDS-related deaths are not decreasing.<sup>20,22</sup>

### Tuberculosis

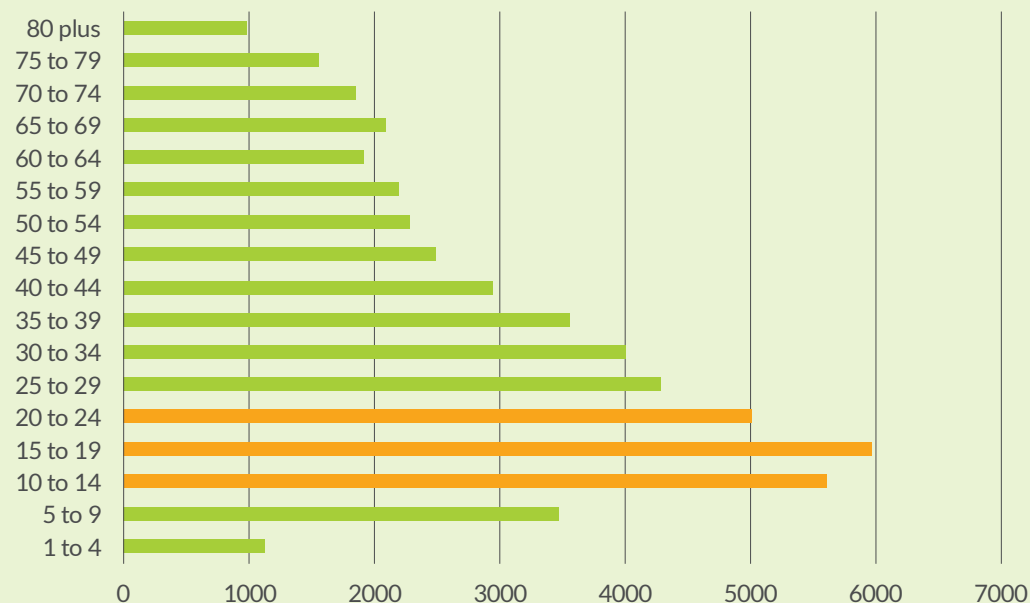
In countries where HIV is prevalent, TB incidence also peaks in younger age groups due to their close relationship.<sup>23,24</sup> From school-age onwards, children also become more exposed to TB because of getting in contact with more people outside their home, such as at school.<sup>25,26,27,28,29</sup> Prevalence of latent TB can be high in adolescents<sup>30,31</sup> and disease progression in this age group is more rapid than in adults.<sup>8,32</sup> As with HIV, detection and treatment adherence for TB is generally poorer in adolescents than in adults.<sup>33,34,35,36,37</sup>

### Water- and soil-borne helminthiases

As children become more active, and spend more time playing and swimming outdoors, they become more susceptible to helminthic infections (parasitic worm infections) that are transmitted through contact with water, such as schistosomiasis (flukes), or the soil, such as ancylostomiasis (hookworm infection), trichuriasis (whipworm infection), ascariasis (large roundworm infection) and strongyloidiasis (threadworm infection).<sup>38,39</sup> Prevalence in the GBD database of 2015 peaks in adolescence for all three these infections, and

then slowly reduces as immunity increases (figure 1).<sup>40,41,42</sup> The latest edition of 'Disease Control Priorities in Developing Countries' concluded that the maximum prevalence of ancylostomiasis and schistosomiasis is usually reached in adolescence or in early adulthood, but situated the peak of ascariasis and trichuriasis before five years of age, due to a higher transmission rate.<sup>43</sup> In endemic countries, infections are an important cause of anaemia, in particular in adolescent girls.<sup>8,44,45,46,47,48,49,50,51,52,53</sup> increasing the risk of maternal death during pregnancy.<sup>54</sup> Worm infections are also linked to school absenteeism and low school performance.<sup>8,55,56</sup> In addition, they have been related to poor nutritional status in adolescents.<sup>57</sup> Adolescents' knowledge about helminthic infections is often low.<sup>58</sup>

**Figure 1: Prevalence of schistosomiasis per 100,000 persons, by 5 years age categories, in 2015**





### Other PRNDs with highest burden in young people

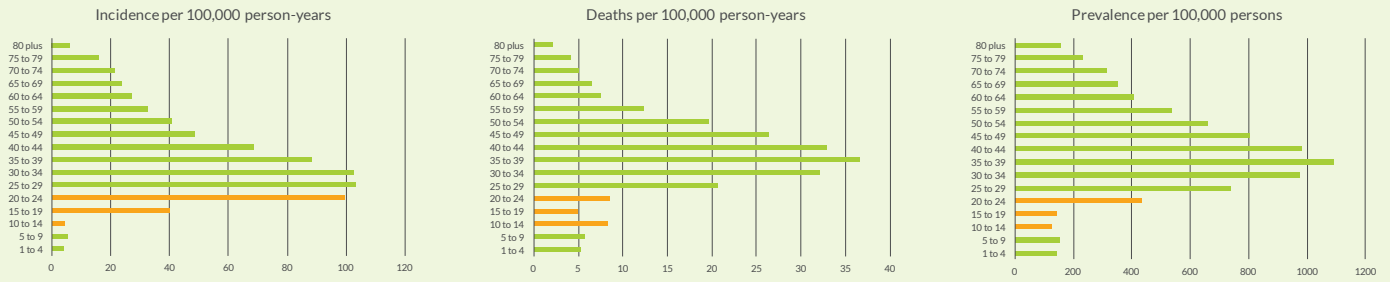
Although young children remain the age group most at risk of dengue infection, several countries have noted a shift of the burden of the disease from children to adolescents and young adults.<sup>59,60,61,62,63,64,65,66,67,68,69,70</sup> This is reflected in the 2015 GBD database where the highest incidence of dengue is seen in the 10-14 years age group (Annex 2). A possible explanation is that as the prevention of infection in young children becomes more effective, young people have developed less immunity. Human African trypanosomiasis (sleeping sickness) mainly affects adolescents and young people and incidence peaks in the 20 – 24 years age group.<sup>71</sup> The infection can cause loss of memory and ability to concentrate, and this might affect the school performance of school-aged children.<sup>72</sup>

Pneumococcal and meningococcal meningitis prevalence peaks in young people, as a result of increased social mixing behaviours, including bar attendance, smoking, or more than one kissing partner.<sup>73,74,75,76</sup> In 2015, meningitis ranked third as a cause of death among adolescents in African LMICs (2). There is little data about age-specific incidence rates of rabies, but studies suggest that adolescents, in particular male adolescents are worst-affected by the disease.<sup>77,78</sup>

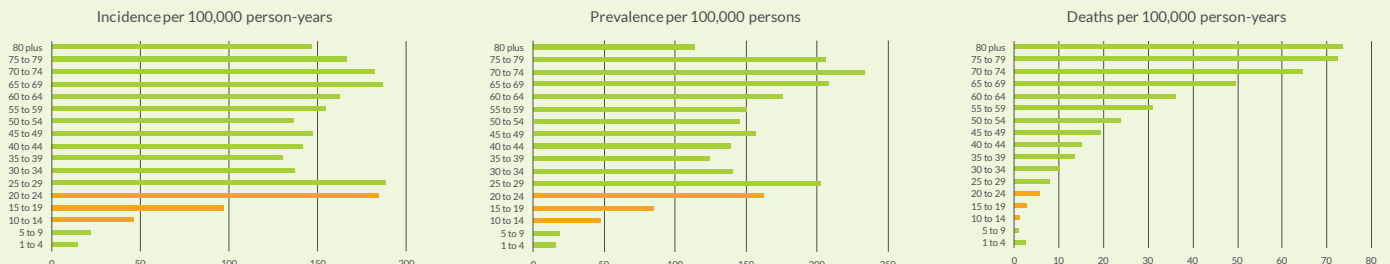
Age specific incidence of dracunculiasis (Guinea-worm disease) and onchocerciasis (river blindness) is not well documented, but they appear to peak at young age. Guinea-worm disease occurs in all age groups but it is more common among young adults aged 15 – 45 years old.<sup>79,80,81,82</sup> It is thought they are more likely to drink contaminated stagnant water while away from home, and as a result are more likely to be susceptible to infection.<sup>83</sup> It is a severely disabling disease and therefore a frequent cause of school drop-out in those affected.<sup>84</sup> River blindness shows a comparable pattern, peaking in the 15 - 35 age group.

## PRNDs with the largest burden in young people

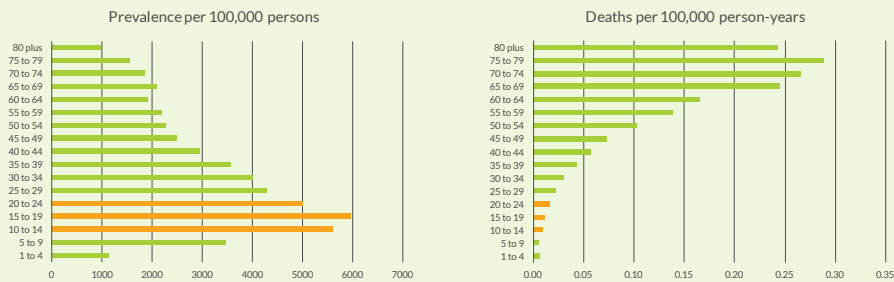
### HIV



### TB

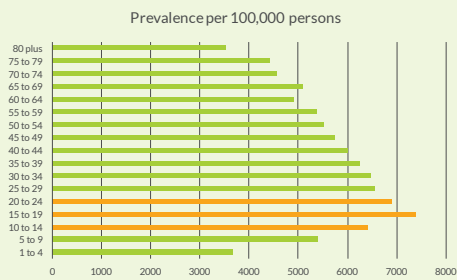


### Schistosomiasis

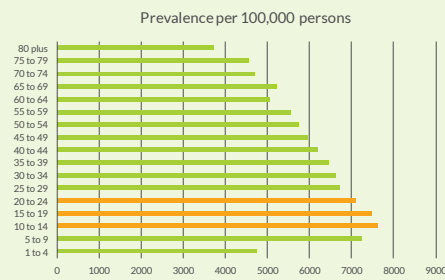


### Soil-transmitted helminthiases

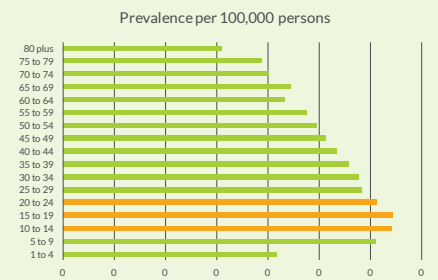
#### Hookworm



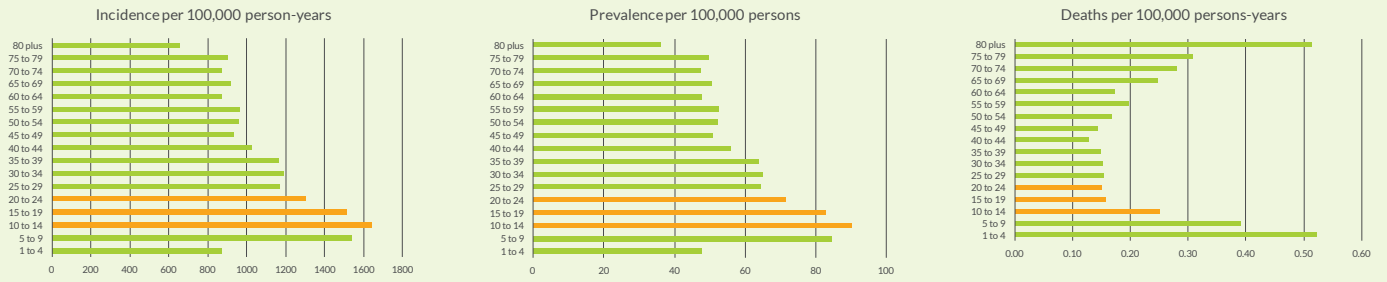
#### Whipworm



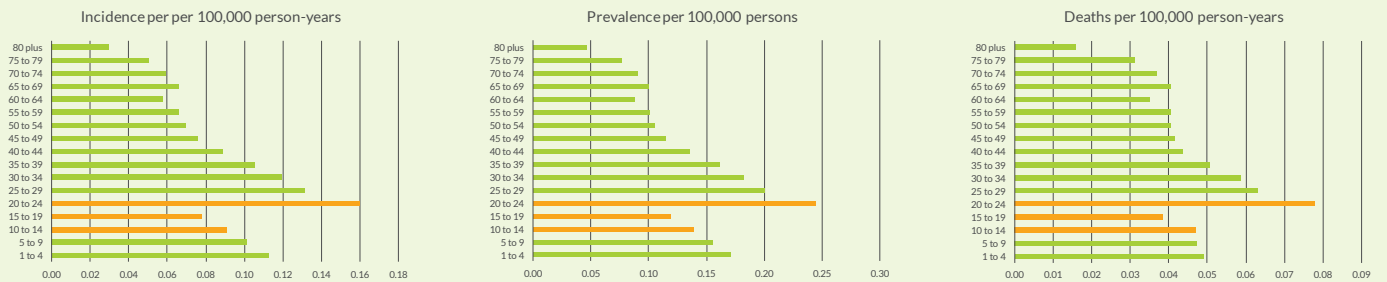
#### Ascariasis



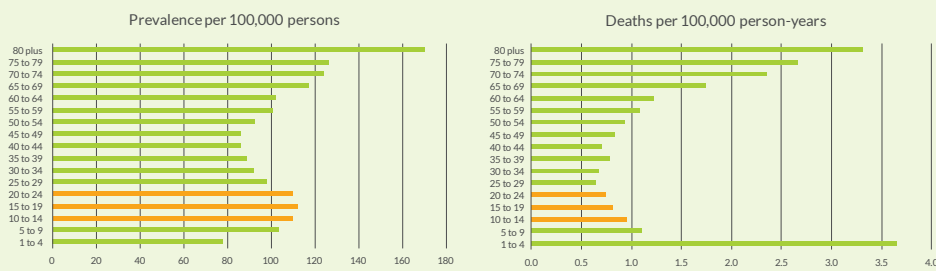
## Dengue



## Human African trypanosomiasis (sleeping sickness)



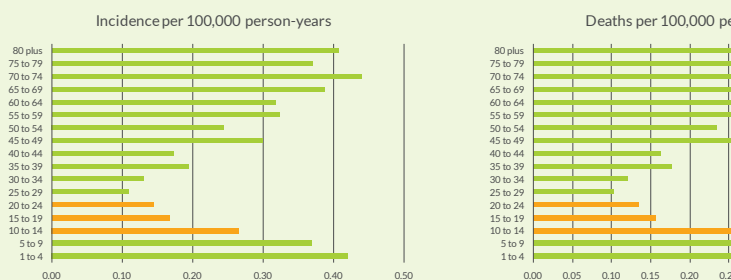
## Pneumococcal meningitis



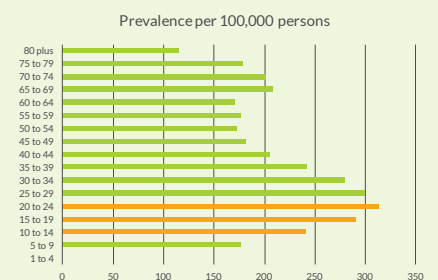
## Meningococcal meningitis



## Rabies



## Onchocerciasis (river blindness)



## Group 2: PRNDs with the largest burden in young children, followed by adolescents and youth

Group 2 are infections for which young children are the most vulnerable and of which the incidence gradually declines during live time because of increasing (partial) resistance. Incidence is, however, still high during adolescence and youth, and substantially higher than among older adults. For some of these diseases, infections acquired during childhood only start presenting clinical signs during adolescence and youth.

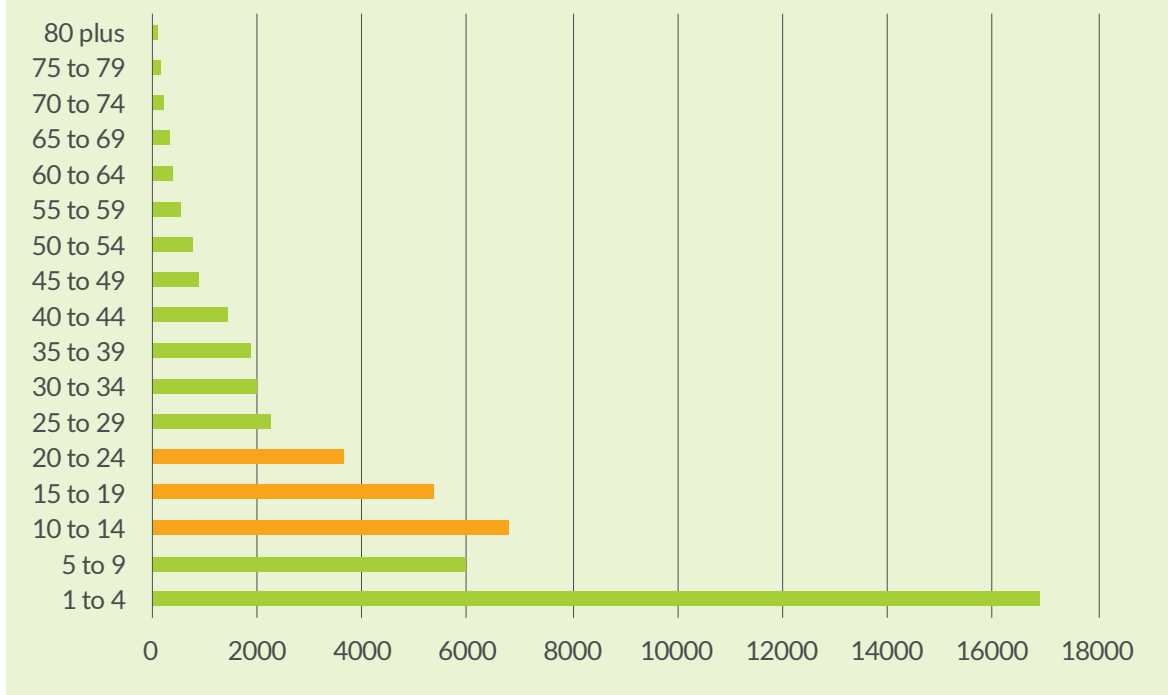
### PRNDs with highest burden in young children

- Malaria
- Diarrheal diseases
- Bacterial pneumonia
- Typhoid and paratyphoid fever
- Rheumatic fever
- Leishmaniasis
- Trachoma
- Lymphatic filariasis
- Yaws
- Buruli ulcer

### Malaria

Malaria is an example of this epidemiological profile (figure 2). Young children have the highest infection rate because of lack of immunity. Incidence then gradually decreases as partial immunity develops. Nevertheless, incidence is still substantially higher among young people than among older people.<sup>85</sup> It is among the top ten causes of death in adolescents worldwide<sup>3</sup> and an important cause of anaemia and school absence.<sup>8,86,87</sup> Of particular concern is malaria in young pregnant women because of the serious risks it presents for the pregnancy.<sup>85,88</sup> It is proposed that successes in lowering malaria transmission in young children will result in less immunity in young people, and increase incidence in this age category<sup>89,90</sup> over time. Knowledge among adolescents about malaria transmission and its prevention is often low.<sup>91,92,93</sup>

**Figure 2: Incidence of malaria per 100,000 person-years, by 5 years age categories, in 2015**



### Diarrheal diseases, including salmonella infections, and bacterial pneumonia

Diarrheal diseases and other infections acquired through faecal-oral contact, such as typhoid and paratyphoid fever, have the highest incidence in young children, but are still common in adolescents.<sup>94,95</sup> A similar pattern is seen for bacterial pneumonia. As with malaria, diarrheal and lower respiratory infections are estimated to be among the top causes of death, not only among children, but also among adolescents<sup>3</sup>. Together with meningitis, diarrhoea and respiratory infections are the top three causes of adolescent death in African LMICs.<sup>20</sup>

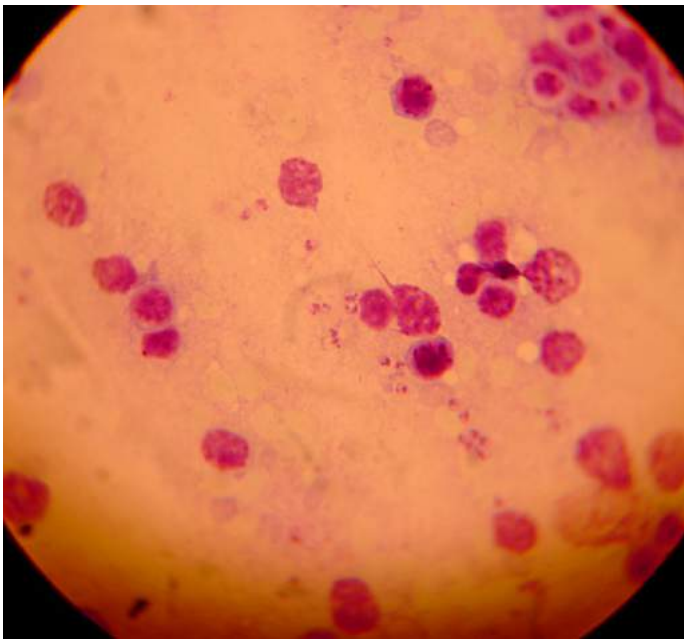


Photo: Michael Wunderli

#### Rheumatic fever

Infection by the causal bacterial streptococcus mostly occurs during childhood, but the health complications start occurring during adolescence and young age.<sup>96,97,98</sup> Rheumatic heart disease is the biggest cardiac cause of morbidity and mortality in the world's youth.<sup>97,99</sup>

#### Leishmaniasis

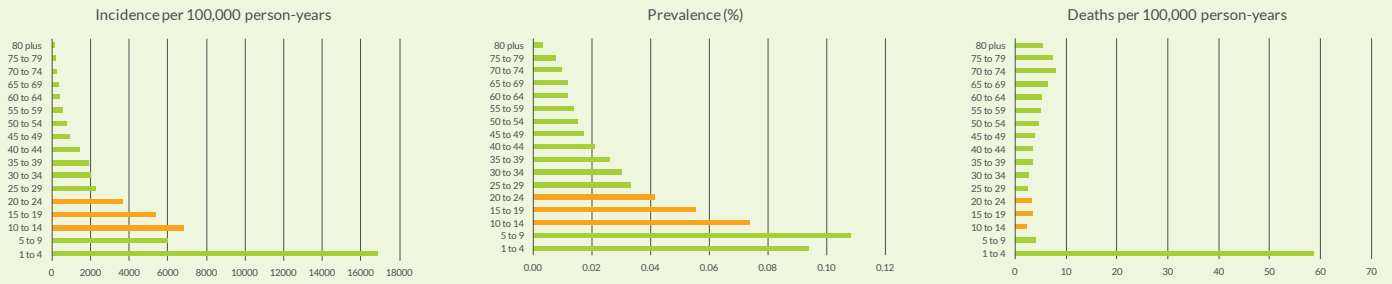
While infection by this parasite is highest during childhood, it is still high during adolescence and youth,<sup>100,101,102,103</sup> and these latter age groups have the highest occurrence of the clinical disease. Most of the deaths caused by leishmaniasis occur at age 5-29 years. Disfiguring scars can lead to social and psychological problems.<sup>104,105</sup> Knowledge about the disease among middle- and high-school students has found to be low in some settings.<sup>106</sup>

#### Other PRNDs with highest burden in young children

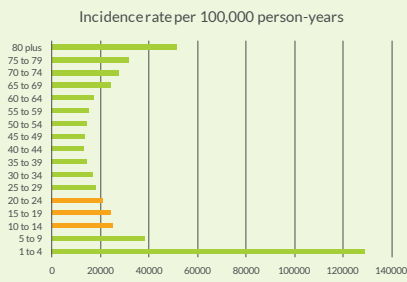
Infection of the eye by the chlamydia bacteria occurs mostly during childhood. However, clinical signs of trachoma, which is the world's biggest infectious cause of blindness, such as scarring, first manifest themselves in teenagers. Even the more advanced stages, such as trichiasis, can already occur in individuals in their 20s or younger.<sup>107,108,109,110,111,112,113</sup> Similarly, lymphatic filariasis, commonly known as elephantiasis, is mostly acquired during childhood, but primary lymphedema (localised fluid retention and tissue swelling) often develops in young people.<sup>114,115,116,117,118</sup> Scabies, a condition caused by parasitic mites, and head lice are most prevalent in children, more than in adolescents or youth, but also common in school children,<sup>119,120,121,122</sup> in particular at boarding schools.<sup>123</sup> There is little information available on age-specific incidence rates of yaws and Buruli ulcer, bacterial diseases that can involve skin, soft tissue, bone and cartilage, but infection is believed to mostly happen in children and young adolescents.<sup>124,125,126</sup> According to WHO, about 48% of those affected by Buruli ulcer in Africa are under 15 years old<sup>127</sup> and yaws peaks between 6-10 years.<sup>128</sup>

## PRNDs with the largest burden in children

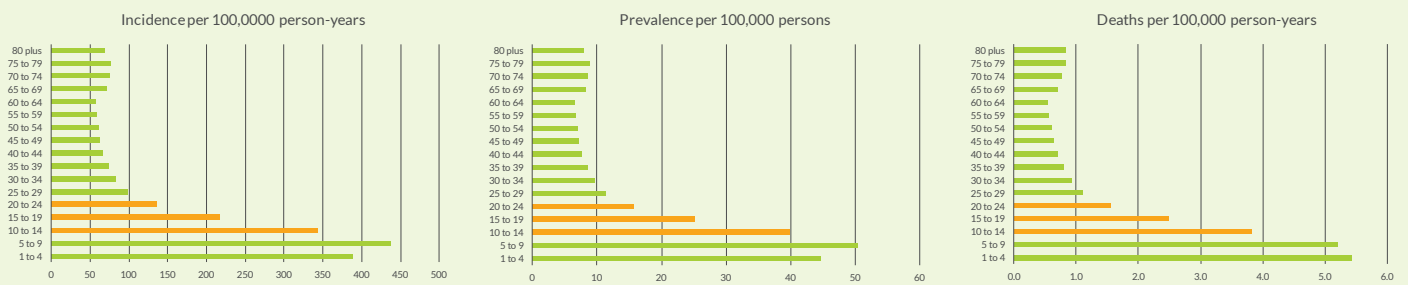
### Malaria



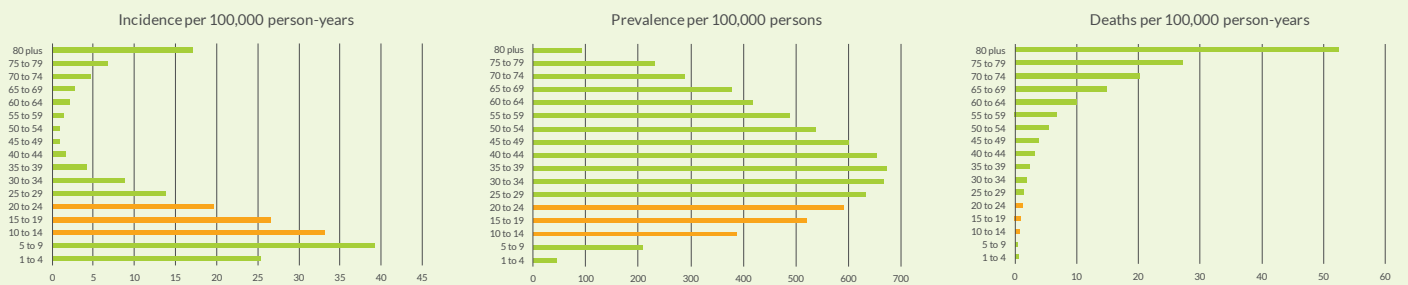
### Diarrhoeal diseases



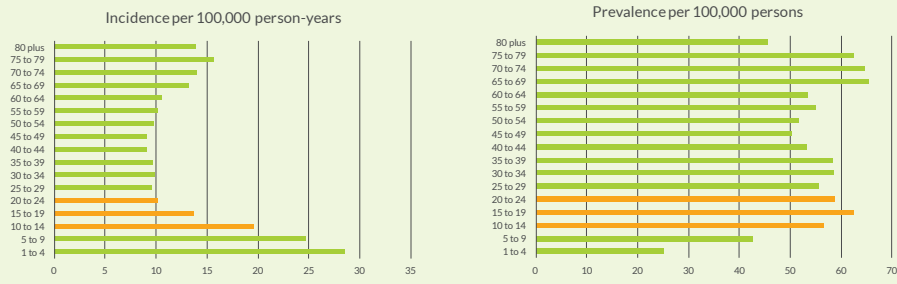
### Typhoid fever



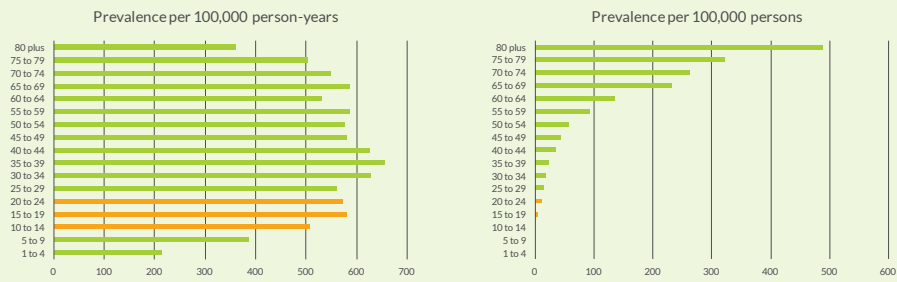
### Rheumatic heart disease



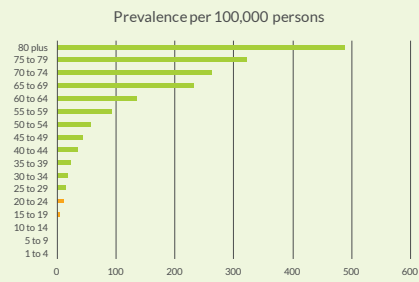
## Leishmaniases



## Lymphatic filariasis



## Trachoma eye disease





### Group 3: PRNDs with the largest burden at a later age

The third group are diseases that mostly affect adults, and are not an important cause of morbidity or mortality in young people. Nevertheless, for some of these diseases it may be relevant to include young people in screening, education and sensitisation programmes.

#### Leprosy

Infection with the mycobacterium causing leprosy may occur early in life, but the symptoms appear mostly at a later age.<sup>129,130</sup> Nevertheless, it is important to start detection from childhood and early adolescence onwards.<sup>131</sup> Adolescents with leprosy often have a different clinical expression of the disease<sup>132</sup> and can suffer mental health problems.<sup>133,134,135</sup> Stigmatisation of leprosy patients by adolescents is common.<sup>136</sup>

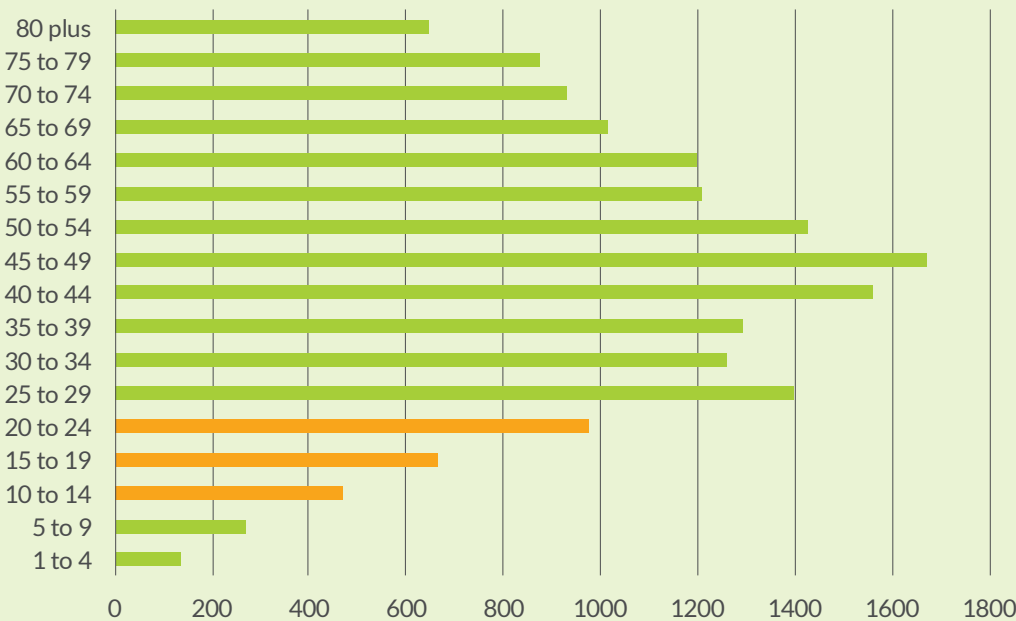
#### Foodborne trematodiasis

Infection by trematodes (flake worms), such as clonorchis, opisthorchis and fasciola, that are acquired by consuming fish, vegetables and crustaceans, mostly occur in adults as the main consumers of these foods (Figure 3). Incidence can however be high in children and adolescents as well<sup>137</sup>, and sensitisation needs to be initiated before adulthood.<sup>138</sup>

#### PRNDs with highest burden in adults

- Leprosy
- Foodborne trematodiasis
- Chagas' disease
- Cysticercosis
- Echinococcosis
- Mycetoma
- Deep mycoses
- Leptospirosis
- Venomous snakebites
- Hepatitis C
- Cryptococcal meningitis
- African viral haemorrhagic fevers

**Figure 3: Prevalence of foodborne trematodiasis per 100,000 persons, by 5 years age categories, in 2015**



#### Other PRNDs that mostly affect adults

Infection by *Trypanosoma cruzi*, the unicellular parasite causing Chagas' disease and only found in the Americas, occurs in all ages, but clinical symptoms occur mostly in adults.<sup>139,140</sup> Nevertheless, it can also be a cause of cardiac and other problems in adolescents.<sup>141,142,143</sup> Cysticercosis and echinococcosis, both caused by tapeworm cysts, present mainly in adults but can also occur in adolescents and young people. In endemic areas, the cerebral form of cysticercosis (neurocysticercosis) is an important cause of seizures in adolescents.<sup>143,144,145,146</sup> Mycetoma, a progressively destructive inflammatory disease caused by fungi or bacteria, affects people of all ages, and commonly young adult males aged between 20-40 years.<sup>147,148,149</sup> Chromoblastomycosis and other deep fungal infections are mostly a disease



of middle-age male farmers, who in turn can infect their adolescent relatives.<sup>150,151,152</sup> Leptospirosis is mostly an occupational hazard for farmers and mine workers, amongst others, and therefore more common in male adults. There is limited data on its incidence in adolescents<sup>153</sup> and it is more severe in adults compared to children.<sup>154,155</sup> Knowledge and self-reported practices regarding leptospirosis among adolescent school children is often low.<sup>156</sup> Venomous snakebites are said to occur mostly in adult males, but can happen to all ages.<sup>157,158,159,160,161,162</sup> Unsafe health-care procedures and injection drug use are the leading causes of new Hepatitis C infections.<sup>163,164</sup> In high income

countries, infection in young people is closely related to intravenous drug use<sup>165,166,167,168,169</sup> and, to a lesser extent unsafe piercing and tattooing.<sup>170,171</sup> In sub-Saharan Africa, iatrogenic causes (related to medical examination or treatment) appear more important.<sup>172</sup> Cryptococcal meningitis is mostly an opportunistic infection in people with HIV, and therefore only relevant for this sub-population. Data show that epidemics of African viral haemorrhagic fevers, such as Ebola, often relatively spare children and adolescents.<sup>173</sup> However, they can be affected indirectly by being orphaned.<sup>174,175,176</sup>

## Burden of PRNDs in eastern Africa

Poverty-related diseases are common in the eastern African region. HIV, TB, malaria, diarrheal diseases and lower respiratory infections are important causes of death and disability adjusted life years (DALY) lost in Ethiopia, Uganda, Kenya and Tanzania, including among adolescents.<sup>177,178</sup> Adult HIV prevalence (15 years and older) in 2015 was estimated to be 7.1% in Uganda, 5.9% in Kenya, 4.7% in Tanzania and 2.4% in Ethiopia.<sup>179</sup> As in other sub-Saharan African countries, adolescent girls in the region are particularly vulnerable to HIV. Ethiopia, Kenya and Tanzania rank amongst the world's highest-burden countries for TB.<sup>23</sup> In Ethiopia, 58% of cases are under 35 years of age.<sup>180</sup> In Uganda TB remains a major public health problem.<sup>23,181</sup> Malaria is endemic in all four countries.<sup>182</sup> Rheumatic heart disease remains prevalent and is associated with high rates of morbidity and mortality.<sup>183,184,185</sup>

Also most NTDs are common in the eastern African region:

### Ethiopia

In Ethiopia, Guinea worm disease, leishmaniasis, lymphatic filariasis, river blindness, schistosomiasis, soil transmitted helminthiasis and trachoma are the NTDs with the highest disease burden.<sup>186,187,188,189,190,191</sup> Leprosy continues to be highly prevalent and Ethiopia globally ranks among the 13 countries with the highest burden.<sup>131</sup> Strongyloidiasis and rabies are also present.<sup>187,190,192</sup> No cases of sleeping sickness have been reported since 1984.<sup>190</sup>

### Kenya

In Kenya, soil-transmitted helminthiasis, schistosomiasis, lymphatic filariasis, trachoma, leishmaniasis, dengue, rabies, Guinea worm disease, leprosy, cystic echinococcosis and taeniasis, food borne trematodiasis, river blindness, sleeping sickness, mycetoma and snake bites are either suspected or confirmed to be endemic.<sup>193</sup>

### Tanzania

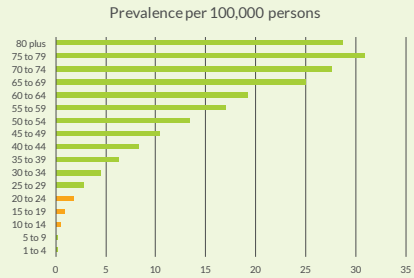
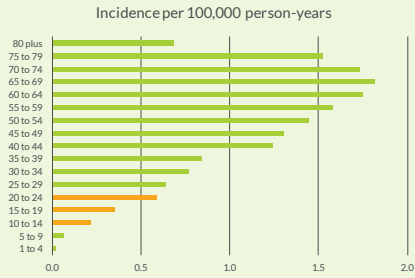
Schistosomiasis, soil-transmitted helminths, lymphatic filariasis, river blindness and trachoma are endemic in many areas of Tanzania,<sup>194,195</sup> as well as sleeping sickness, rabies, echinococcosis and taeniasis (cysticercosis).<sup>196</sup> Leprosy continues to be an important public health problem.<sup>197</sup>

### Uganda

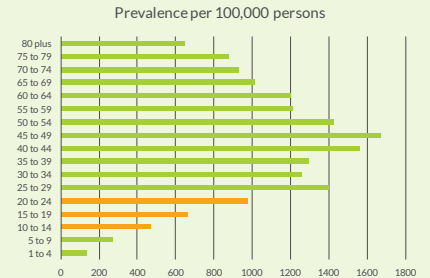
The NTDs of major public health importance in Uganda are soil transmitted helminths, schistosomiasis, lymphatic filariasis, river blindness, and sleeping sickness. The prevalence of other NTDs in Uganda remains less clear. Visceral leishmaniasis, trachoma and Buruli ulcer are known to be endemic in some districts. There is still leprosy in some parts of the country, but it is no longer considered as a national public health problem. Guinea worm disease was eliminated by 2003.<sup>198,199</sup>

PRNDs with the largest burden at a later age

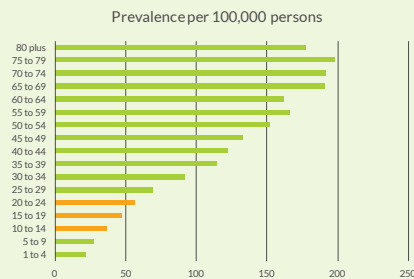
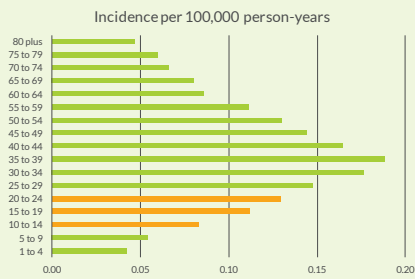
Leprosy



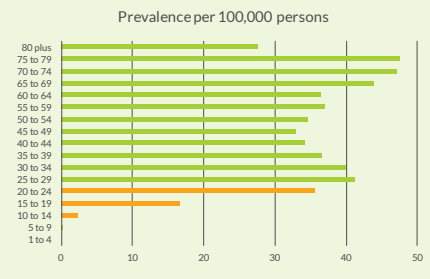
Foodborne trematodiasis



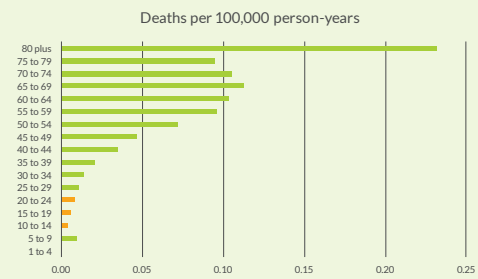
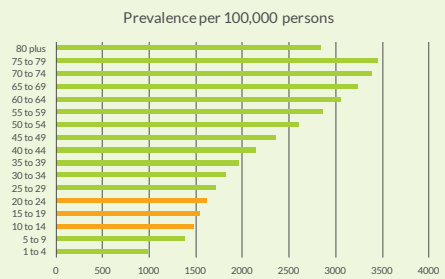
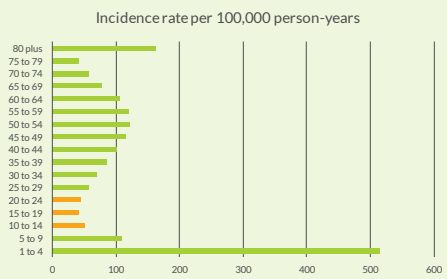
Chagas' disease



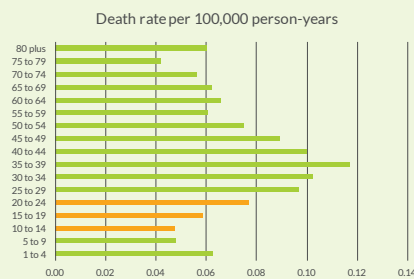
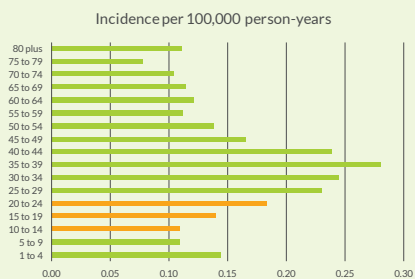
Cysticercosis



Hepatitis C



Ebola



FINDINGS

## ADOLESCENT- AND YOUTH-FOCUSED APPROACHES TO FIGHTING PRNDS

### Inclusion of young people in PRND control strategies

With the exception of HIV & AIDS and worm infections, adolescents or young people are rarely mentioned as a specific population in international strategic documents for the control of PRNDs.

#### HIV & AIDS

The importance of targeting young people, and especially young women and adolescent girls, in HIV prevention and control has been long-recognised<sup>11</sup> and several guidelines for HIV interventions specifically targeting these groups have been developed. The most recent documents specify that programmes should focus on information to acquire knowledge, opportunities to develop life skills, appropriate health services for young people, and the creation of a safe and supportive environment.<sup>200</sup> Essential components of effective interventions among young people include condom promotion and distribution, intensive social and behaviour change communication programmes, school-based HIV prevention, pre-exposure prophylaxis, and accelerated uptake of HIV testing services, antiretroviral therapy and voluntary medical male circumcision<sup>12</sup>. In recent years, young people who are particularly vulnerable, such as sex workers, clients of sex workers, men who have sex with men and injecting drug users of young age, are receiving increased attention,<sup>200,201</sup> and the need to develop interventions specifically targeting these populations is now recognised.<sup>202,203</sup>

#### Worm infections

School-aged children, roughly corresponding with the 6-15 years age group and therefore partly overlapping with adolescents, are mentioned as an important target group in strategic documents for the control of several helminthic infections, including schistosomiasis,<sup>204</sup> soil-transmitted helminthiases,<sup>49</sup> trachoma,<sup>107</sup> foodborne trematodiasis,<sup>138</sup> and to some extent also Guinea worm disease and strongyloidiasis.<sup>49,205</sup>

#### In the eastern African countries

The country-specific national policies and strategies in the four eastern African countries follow the same pattern. All identify adolescents and young people as an important target population in HIV control,<sup>206,207,208,209</sup> but strategic documents of other PRNDs rarely list adolescents or young people as a group that needs special attention. School-aged children, on the other hand, are commonly mentioned. Schools are considered an appropriate setting for delivering health education and communication on TB,<sup>197,210,211,212</sup> and in some guidelines also for screening.<sup>210,211</sup> In the control of malaria, schools are mentioned among the appropriate places for the distribution of long-lasting insecticidal nets (LLIN), and for mobilising and informing school pupils and engaging them as educators.<sup>213,214,215,216,217,218</sup> Strategic documents for the control of NTDs identify school children as a critical population for mass drug administration (MDA), in particular for schistosomiasis and soil-transmitted helminths,<sup>191,198,193,196</sup> but also for lymphatic filariasis, trachoma and river blindness.<sup>198,193,196</sup>

### Inclusion of PRNDs in young people's health programmes

#### Young people's health strategies

Few PRNDs are mentioned in strategic documents on young people or adolescents' health. The most recently developed documents by WHO and others generally only list the major poverty-related diseases as important diseases to be included in adolescent health programmes: HIV & AIDS, lower respiratory infections, diarrhoeal diseases, meningitis, malaria and TB.<sup>2,5</sup>

#### Adolescent-friendly health services

Strategies to improve adolescents' access to health services, also usually focus on HIV and SRH.<sup>219,220</sup> The latest WHO guidelines to make health services more adolescent-friendly include 'endemic diseases (e.g. TB and malaria)' among the health problems to be addressed.<sup>221</sup>

### School-based health strategies

Strategic documents on school-based health programmes include a broader range of PRNDs. Schistosomiasis, soil-transmitted and other worm infections, malaria and TB are commonly listed, alongside HIV, as diseases of concern.<sup>222</sup> As part of its school health series documents, WHO developed a strategic document for malaria prevention and control at schools,<sup>223</sup> and for helminth control in school-age children.<sup>224</sup>

### In the eastern African countries

While recent international guidelines appear to be broadening the range of diseases to be addressed by adolescent health programmes (see above), this evolution is still not seen in the national guidelines of the four eastern African countries under review. No general national strategic documents on young people or adolescent health were identified, in any of the countries. All four do, however, have adolescent health strategies in place which focus on SRH.<sup>225,226,227,228,229</sup> Ethiopia and Kenya both have a national school health strategy. The Ethiopian strategy lists school-based activities for HIV, TB, schistosomiasis and other helminthic infections.<sup>230</sup> The Kenyan strategy has a 'Disease Prevention and Control' section that includes sensitisation of school communities on transmission, prevention and control of targeted preventable diseases in general, and school-based deworming and distribution of LLINs in specific.<sup>231</sup> Both also include water, sanitation and hygiene (WASH) to reduce diarrhoeal diseases.



## PRND interventions with young people

Examples of interventions or programmes that specifically address the problem of PRNDs in young people are scarce, again with the exception of HIV & AIDS programmes. Relevant interventions include school-based programmes, out-of-school sensitisation focussing on behaviour change, adolescent-friendly health services, adolescent mass treatment and adolescent vaccination.

### School-based programmes

Schools offer a unique opportunity for health interventions. They can reach the majority of children and young adolescents in a cost-effective and sustainable manner. Furthermore, schools have been given the responsibility to enhance all aspects of development of children and youth under qualified guidance.<sup>222,223,232</sup>

### HIV & AIDS

School-based interventions addressing HIV, and other SRH issues, are being implemented worldwide. They can consist of adult-led, curriculum-based interventions and many countries, including our eastern African countries, have integrated these topics in their school curricula.<sup>233,234,235</sup> School-based HIV programmes can also be non-curriculum-based and peer-led.<sup>234,235</sup> Critical features for effective school-based education and information programmes include (1) provide evidence and reassurance to policy-makers, parents, teachers and school officials of the beneficial effects of SRH education programmes; (2) implement SRH education programmes that are curriculum based and led by



adults; (3) ensure skill-based intervention programmes; (4) incorporate the identified characteristics of successful SRH education programmes; (5) provide access to services and commodities for prevention of reproductive health problems.<sup>232</sup>

Several reviews have been conducted of studies assessing the efficacy of school-based HIV prevention, with varying results.<sup>236</sup> Knowledge and attitude-related outcomes appear the most easy to change, but altering behavioural intentions is more difficult and actual behaviour change is least likely to occur.<sup>237,238,239,240</sup> Curriculum-based interventions incorporating key characteristics and led by adults had the strongest evidence of effectiveness and showed positive reports of behaviour change.<sup>232,241,242</sup> A 2017 review concluded that comprehensive interventions, those specifically targeting HIV prevention, and school-based clinics were found to be effective in improving knowledge and changing attitudes.<sup>243,244</sup>

### Helminthic (worm) infections

School-based programmes for the control of helminthic infections have mostly focused on MDA (see below).<sup>39</sup> Other components that are sometimes integrated in school health programmes include health education, health services and environmental modifications.<sup>224</sup> Skills-based health education focuses on increasing knowledge and improving attitudes and behaviours related to helminthic infections.<sup>245,246</sup> Screening and treatment is an excellent entry point for the delivery of health services in schools.<sup>224</sup> Examples of environmental modifications are hygienic facilities, such as school latrines and hand washing facilities, safe water supply and safe disposal of waste.<sup>224</sup>

### Malaria

Several school-based activities for the control of malaria are recommended and being implemented. Skills-based health education in schools may be an effective way to promote recognition of disease symptoms for prompt treatment,<sup>223,247</sup> although a 2012 review concluded that school text books rarely included knowledge and skills that are crucial to protect schoolchildren and their families from malaria.<sup>248</sup> Providing free bed nets to schoolchildren may bring individual and community benefits and should be widely promoted.<sup>223,249</sup> Intermittent preventive treatment (IPT) of malaria in schoolchildren is another school-based strategy that is being explored. Pilot studies have shown promising results.<sup>90,250</sup> but reviews concluded that more studies assessing efficacy of IPT in particular against malaria-related anaemia and clinical malaria in schoolchildren must be conducted.<sup>249,251</sup> Problems with finance and drug distribution diminished effectiveness and led to the eventual emergence of drug resistance in previous efforts during the 1950s and 1960s to deliver chemoprophylaxis to schoolchildren in Africa.<sup>247</sup>

## Other PRNDs

School-based TB education, screening and testing of adolescent students have been suggested as a possible effective strategy, both in developed<sup>252</sup> as in high-burden LMICs.<sup>25</sup> School-based education has also been recommended for foodborne trematodiasis.<sup>138</sup> School-based screening for acute rheumatic fever and for rheumatic heart disease, using echocardiography, has been recommended in endemic areas.<sup>253,254,255</sup> In highly endemic areas, some providers choose to empirically treat patients in the 5 - 15 year age range with fever and complaints of sore throat, even without any laboratory evidence of streptococcal infection.<sup>255</sup>

## Out-of-school interventions

While schools offer an easy and efficient platform to reach children and young adolescents, they are less efficient in reaching older adolescents and youth. In LMICs, where many children drop-out of school at a young age, there is a need to complement school-based programmes with out-of-school interventions.

## HIV & AIDS

Experiences with out-of-school PRND programmes targeting young people are almost all related to HIV. Several approaches and models have been piloted and tested. These include peer education, youth or sport club-based interventions, e-health and m-health interventions, mass media targeting young people, among others. The performance of these interventions varies and many have limited duration or coverage. Reviews of HIV prevention programmes for young people have concluded that it is difficult to change young people's behaviour.<sup>256,257,258,259</sup>

A systematic review of community-based HIV interventions for young people concluded that interventions delivered through existing organisations or centres were most likely to be sustainable and yield positive results.<sup>260,261</sup> Peer education and counselling is a popular and flexible approach that has been used in many different contexts and programmes.<sup>302</sup> Several programmes have demonstrated positive results, and the important role of peer education in the promotion of adolescent health is emphasised.<sup>234,262,303</sup> Yet, there is less conclusive evidence from scientific studies. A recent review of studies assessing the impact of peers in adolescent sexual behaviour in Sub-Saharan Africa observed that all studies found evidence for an association between peers and at least one sexual behaviour indicator, but that the studies were very heterogeneous and that better designs were needed in future studies. The assessment of the effect of peer education is complicated because it is usually part of a wider multi-component approach.<sup>263</sup> Similarly, there is further need for scientific research on the effectiveness of youth centres and one-off public meetings in facilitating young people's access to SRH services, changing their behaviours, or influencing social norms around adolescent SRH.<sup>259,264,240</sup>

A systematic review of reviews of effective approaches to reduce adolescent vulnerability to HIV infection, HIV risk, and HIV-related morbidity and mortality in 2014, concluded that some interventions in geographically defined communities can positively impact important HIV-related outcomes. Community-wide interventions (in defined communities) had an effect if creating their own structure of delivery. Additionally, there was promising evidence that some cash transfer interventions can positively affect HIV outcomes in adolescents, though additional results from a number of ongoing trials and careful consideration of cost-effectiveness and sustainability were required before these could be recommended for scaling up.

There is evidence from high-income countries that mobile phone interventions are effective in HIV prevention among young people, but less from LMICs. Studies provide preliminary evidence indicating that social media and text messaging can increase knowledge regarding the prevention of STIs, but additional research is needed to determine the most effective and engaging approaches.<sup>265,266</sup> A more recent review of mobile health interventions in LMICs concluded though that mobile phones are becoming a more common method to connect youth to SRH information and services, and that evidence is emerging that they are an effective way to reach young people and to achieve knowledge acquisition and behaviour change.<sup>267</sup>

In LMICs, mass media programmes can influence HIV-related outcomes among young people, although not on every variable or in every campaign. A review concluded that comprehensive mass media programmes are valuable and that campaigns that include television yield the strongest evidence of effects.<sup>268</sup>

## Other PRNDs

The scarce examples of out-of-school interventions targeting PRNDs control in adolescents or youth, other than for HIV, include youth-focused community-based interventions to increase awareness on TB,<sup>269</sup> behavioural interventions to enhance TB treatment adherence<sup>270</sup> and targeted routine latent TB treatment among adolescents out of school.<sup>30</sup> In countries where school enrolment is low, community-based schistosomiasis interventions have been implemented to reach children not attending classes.<sup>204</sup> Health education for children and adolescents to avoid contact with the sick and their body fluids during Ebola epidemics is another example.<sup>173</sup>

## Adolescent-friendly health services

A range of barriers hinder the use of health services by young people, and in particular adolescents. They may not know where and when health services are provided; health facilities may be located a long distance from where they live/study/work; health services may be expensive and beyond their reach; and health services may be delivered in a way that adolescents do not want to obtain them.<sup>221</sup> To respond to this, in many countries, non-governmental organisations (NGOs) are involved in providing health services that are intended to specially respond to the needs of adolescents, and to be “friendly” to them.<sup>220</sup> These services only currently exist for SRH.

According to WHO, adolescent friendly health services consist of: (1) competent service providers who are non-judgemental and considerate in their dealings with adolescents; (2) facilities that are equipped to provide adolescents with the health services they need, and are appealing to adolescents; (3) making adolescents aware of where they can obtain the health services; and (4) making community members aware of the health-service needs of adolescents, and support their provision.<sup>221</sup>

Most of these initiatives are small in scale and of limited duration, and often also of uncertain quality.<sup>220</sup> Their effect is sometimes questioned.<sup>240,271,272,273</sup> However, there is a steadily growing number of initiatives that have moved beyond the ‘pilot’ or ‘demonstration project’ stage to scale up their operations to reach out to adolescents across an entire district, province or country. Similarly, there is growing evidence for the effectiveness of some of these initiatives in improving the way health services are provided, and in increasing their use by adolescents.<sup>242,264</sup>

Some reviews assessed interventions to increase the use of specific HIV services. Interventions to increase the uptake of HIV testing in young people comprise education and different test delivery methods. Educational programs are found to be effective when delivered in classroom or entertainment-based formats. Health providers offering testing and home testing increase the rate of testing.<sup>21</sup> Provider-initiated testing and counselling has the highest acceptability, family-centred HIV testing lower acceptance compared to home-based testing, and school-linked HIV testing has poor acceptance.<sup>274</sup>

Pre-Exposure Prophylaxis for youth at risk for HIV is another strategy to reduce HIV incidence in young people and evidence suggests a protective benefit. Low adherence is however an important barrier to effective use.<sup>275</sup>

Adolescent-friendly health services focus solely on SRH and no examples were identified on services that encompass other PRNDs. The Indian strategic plan to eliminate leishmaniasis includes screening of adolescents under the Adolescent Sexual & Reproductive Health Programme, but this plan is yet to be operationalised.<sup>276</sup> One study emphasised the importance of integrating malaria and HIV control activities in female adolescents, because of the frequent overlap of these infections.<sup>263</sup>

## Adolescent mass treatment

Periodic anthelmintic drug treatment of school-aged children (mostly defined as 5-14 years) in endemic areas is an evidentially effective strategy to reduce the burden of in particular schistosomiasis and soil-transmitted helminthiasis.<sup>39,49,204,277</sup> The WHO goal is to treat at least 75% of school-aged children in all endemic countries.<sup>278</sup> In areas where lymphatic filariasis, river blindness or trachoma are common, such as in the eastern African countries, these are usually included as well.<sup>191,199,193,196,278,279,280,281,282</sup> Schools are the most efficient delivery channel for treatment<sup>39</sup> and



several countries in Asia have been successful in controlling helminthic diseases using this strategy.<sup>49,224</sup> Countries where school enrolment is low, such as in sub-Saharan Africa, have also implemented community-based treatment with the aim of reaching children not attending classes.<sup>283,284,285</sup> A possible strategy is to have treatment days' at school, where these groups are invited for treatment.<sup>279,286</sup> Some countries are expanding the age range to include adolescents up to 18 years, in particular to reduce the prevalence and intensity of intestinal helminthiasis, and the resulting anaemia, among adolescent girls – as future mothers.<sup>49</sup>

### Adolescent vaccination programmes

While most vaccines are administered during childhood, some are more effective in adolescence. These include the meningococcal conjugate vaccine that is recommended for adolescents aged 11 or 12 years, with a booster dose at 16 years,<sup>287,288</sup> and the rabies vaccine.<sup>289,290</sup>



Photo: Pierre Holtz for UNICEF

The existing Bacillus Calmette-Guérin (BCG) vaccine is effective in preventing severe TB in babies and young children but does not adequately protect adolescents and adults. Revaccination of adolescents with BCG is not recommended.<sup>291</sup> There is therefore a need to develop new TB vaccines to give during adolescence or adulthood. The literature remains divided as to whether vaccines effective pre- or post-infection would provide greatest epidemiological impact. All-age or adolescent/adult targeted prevention of disease vaccines achieve greater and more rapid impact than neonatal vaccines. Mass campaigns alongside routine neonatal vaccination can have profound additional impact. Economic evaluations found TB vaccines overwhelmingly cost-effective, particularly when targeted to adolescents/adults.<sup>292</sup> An adolescent/adult vaccine has potentially the greatest public health impact, but effective delivery of such a vaccine requires a better understanding of global TB epidemiology, improved infrastructure, and engagement of public health leaders and global manufacturers.<sup>293,294</sup> Several TB vaccines are currently being tested in adolescents at high risk of TB infection.<sup>23,295</sup>

A topic that has been given a lot of attention recently is what services the planned HPV vaccination programmes in 9 to 13 years old girls could be integrated with. Interventions that are being considered include helminths treatment and activities for the control of malaria and other mosquito-borne diseases, such as education and distribution of LLINs.<sup>296,297</sup>

### Other interventions

Youth-focused HIV prevention programmes are increasingly paying attention to structural interventions addressing issues such as social norms, gender inequality, and poverty. Some interventions focus on reducing economic drivers that increase sexual risk behaviours. Other focus on changing social norms and thus sexual risk behaviours through communication.<sup>298</sup> Positive youth development is another promising strategy for promoting adolescent health. These are programmes that help youth strengthen relationships and skills, embed them in positive networks of supportive adults, and help them develop a more positive view of their future by providing academic, economic, and volunteer opportunities.<sup>299</sup>



## R&D NEEDS

It is well recognised that there is a significant need for R&D on new and improved interventions to address PRNDs, including the development of effective diagnostics, vaccines, and treatment options, which are currently lacking. These product- and research gaps do, however, concern all age groups. Therefore, documents listing the research priorities for PRNDs, as for example those developed by WHO-TDR on NTDs,<sup>71,300,301,302</sup> rarely list research needs for young people (with the exception of the need for further research on the control of helminthic infections in school-aged children).<sup>300</sup>

The list of potential research topics specifically addressing young people and PRNDs is nevertheless extensive, in other areas of research, such as epidemiology and prevention research, social and political research, implementation research, health economics, and health system research. From the reviewed documents and literature the following can be identified:

### HIV & AIDS

Further research, in particular implementation science research, on:

- behaviour change strategies and approaches targeting young people
- HIV testing strategies and approaches to enhance enrolment in care for young people
- HIV retention in care and treatment adherence in young people, with special attention on HIV positive children transitioning into adolescence
- Pre-exposure prophylaxis in young people: feasibility and cost-effectiveness
- Structural interventions, and combination prevention strategies, for HIV prevention and control in young people
- HIV prevention and control in young key populations

### Tuberculosis

- Vaccine development, and effectiveness and cost-effectiveness of different vaccination strategies
- Effectiveness and cost-effectiveness of different screening strategies in adolescents and youth
- Barriers to TB treatment and determinants of poor treatment adherence in young people, and implementation research on strategies to overcome these

### Malaria

- Changes and trends in epidemiological patterns of malaria, in particular shifts in age-specific incidence rates as a result of successes in lowering malaria transmission in young children



- Implementation research on the effectiveness and cost-effectiveness of school-based malaria control activities, such as providing free bed nets and intermittent preventive treatment

#### Helminthic infections

- Documentation of the effect of national MDA programmes on the prevalence of helminthic infections
- Implementation research on strategies to reach out-of-school adolescents in MDA programmes
- Implementation research on the effect of skills-based health education, school-based and out-of-school, on knowledge, attitudes and preventive practices among adolescents
- Research on the effectiveness and cost-effectiveness of school-based screening and treatment

#### Other PRNDs

- Additional prospective studies on diarrhoeal diseases around the world in older children, adolescents and young adults
- Changes and trends in epidemiological patterns of dengue, in particular shifts in age-specific incidence rates as a result of successes in lowering transmission in young children
- Research on the effectiveness and cost-effectiveness of different strategies for the prevention and for the screening of acute rheumatic fever and rheumatic heart disease in adolescents in LMICs
- Implementation research on the effect of skills-based health education, school-based and out-of-school, on knowledge, attitudes and preventive practices in regard to leishmaniasis among adolescents
- Effectiveness and cost-effectiveness of different leprosy screening strategies in adolescents and youth
- Studies on age-specific incidence rates, and determinants of rabies, yaws and buruli ulcer
- Use of social media to alert young people about African viral haemorrhagic fevers epidemics

#### Cross-cutting

- Implementation research on integration of different disease control activities targeted at young people:
  - Integrated adolescent health policies and programmes
  - Integrated adolescent-friendly health services
  - Integrated school health programmes
  - Integrated out-of-school youth programmes



## CONCLUSIONS

**Young people, both adolescents and youth, are particularly vulnerable to HIV infection and have long been recognised as such. They are also vulnerable to other PRNDs, but rarely specified as a target population for the control of these PRNDs.** For some PRNDs, such as helminthic infections, the most relevant age category to target are school-aged children because these diseases already affect at an earlier age. This age category, usually defined as 6-15 years, partly overlaps with young people, namely young adolescents. School aged children are, to some extent, also targeted in malaria and TB control. PRND programmes, aside from those dealing with HIV, targeting older adolescents and youth are rare.

**Nevertheless, there are arguments for better addressing young people for the control of certain PRNDs.** Mosquito-borne diseases, such as malaria and dengue, are showing a shift in incidence peak from young children to older children and adolescents because of the success of reducing transmission through bed nets. TB is an important problem for young people because of the high morbidity and mortality caused by this disease in this age group, and as a result of specific challenges such as poor detection and treatment adherence. Helminthic infections, such as schistosomiasis and hookworm infection, remain prevalent in older adolescents and are an important cause of anaemia in adolescent girls, which can have serious effects on their reproductive health. The incidence of pneumococcal and meningococcal meningitis peaks in young people, and the diseases are an important cause of death among adolescents. Sleeping sickness mainly affects young people. Diarrheal diseases and pneumonia are more common in adolescents than in older age groups, and are also among the top causes of death in that age category. Rheumatic heart disease is the most important cardiac cause of morbidity and mortality in young people. Leishmaniasis are, in endemic areas, important causes of disfigurement among young people, and this age category has the highest mortality rate for the disease. Trachoma and lymphatic filariasis start showing clinical signs and disabilities already in young people.

**Furthermore, young people, and in particular adolescents, are at a critical age to positively influence their knowledge, attitudes and behaviours.** It is therefore relevant to target them through activities aiming at increasing knowledge on how to prevent infection and recognise symptoms, improving attitudes towards people with these diseases, in particular if they cause disfigurement, and adapting appropriate behaviours in regard to prevention, care seeking and treatment adherence.

While programmes to improve HIV prevention and care in young people are being extensively developed, piloted, tested and scaled-up, these programmes almost always address SRH issues only, and seldom integrate other PRNDs. **Countries where other PRNDs are prevalent should assess to what extent it is feasible, effective, and cost-effective to integrate other PRNDs in these HIV programmes.**

**School health programmes should address a complete package of diseases, including all PRNDs that are endemic in the area.** Critical facts on the epidemiology, transmission, prevention and control of these diseases should be integrated in the school curricula, and adult-led skills-building activities organised. These should not only focus on HIV and SRH, but also on the prevention and care of other PRNDs. Access to health services, for vaccination, screening or treatment, can be ensured by either school-based health services or referrals to external services.

**In countries where school attendance is low, school programmes need to be complemented by out-of-school youth-targeted interventions.** The lessons learned from the HIV & AIDS interventions can serve as inspiration and new disease-specific activities are best integrated within existing community-based HIV/SRH youth programmes.

**Where adolescent-friendly SRH health services exist, the scope of the offered services can be expanded** to include, if endemic, diagnosis and treatment of malaria, TB, diarrheal diseases, pneumonia, meningitis, helminthic infections, leishmaniasis, acute rheumatic fever and rheumatic heart disease.

**Periodic anthelmintic drug treatment needs to address all helminthic infections, prevalent in the area.** It should be done at schools, and in countries where school enrolment is low also in the community. Where prevalence continues high in adolescents, expanding the age range to include adolescents up to 18 years, in particular adolescent girls, should be considered.

**Vaccination of adolescents** is relevant for meningococcal infections and rabies, and, once an effective vaccine has been developed, for TB.



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# Annex 1: List of PRNDs covered by the report

## NEGLECTED TROPICAL DISEASES

- 1. Buruli Ulcer**  
A debilitating mycobacterial skin infection causing severe destruction of the skin, bone and soft tissue.
- 2. Chagas Disease**  
A life-threatening illness, only found in the Americas, transmitted to humans through contact with vector insects (triatomine bugs), ingestion of contaminated food, or infected blood transfusions.
- 3. Chromoblastomycosis and other deep mycoses**  
Chronic cutaneous and subcutaneous infections by fungi eventually leading to emerging, cauliflower-like, mutilating and disfiguring eruptions.
- 4. Dengue**  
A mosquito-borne viral infection causing flu-like illness that may develop into severe dengue and cause lethal complications.
- 5. Dracunculiasis (Guinea-worm disease)**  
A nematode (roundworm) infection transmitted by drinking-water contaminated with parasite-infected water fleas.
- 6. Echinococcosis**  
Infection caused by the larval stages of a tapeworm forming pathogenic cysts in humans and transmitted when ingesting eggs most commonly shed in faeces of dogs and wild animals.
- 7. Foodborne trematodiases**  
Infections acquired by consuming fish, vegetables and crustaceans contaminated with larval parasites; clonorchiasis, opisthorchiasis and fascioliasis are the main diseases.
- 8. Human African trypanosomiasis (sleeping sickness)**  
A parasitic infection spread by the bites of tsetse flies that is almost 100% fatal without prompt diagnosis and treatment to prevent the parasites invading the central nervous system.
- 9. Leishmaniases**  
Diseases caused by a protozoal (unicellular) parasite transmitted through the bites of infected sand flies that in its most severe (visceral) form attacks the internal organs and in its most prevalent (cutaneous) form causes face ulcers, disfiguring scars and disability.
- 10. Leprosy**  
A complex disease caused by a mycobacterial infection mainly of the skin, peripheral nerves, mucosa of the upper respiratory tract and eyes.
- 11. Lymphatic filariasis**  
Infection by microscopic, thread-like worms transmitted by mosquitoes causing abnormal enlargement of limbs and genitals (elephantiasis) from adult worms inhabiting and reproducing in the lymphatic system.
- 12. Mycetoma**  
A chronic, progressively destructive inflammatory skin disease which usually affects the lower limbs. Infection is thought to be caused by the inoculation, through a thorn prick or skin damage, of fungi or bacteria into the subcutaneous tissue.
- 13. Onchocerciasis (river blindness)**  
Infection by parasitic worms transmitted by the bite of infected blackflies causing severe itching and eye lesions as the adult worm produces larvae and leading to visual impairment and permanent blindness.



- 14. Rabies**  
A preventable viral disease transmitted to humans through the bites of infected animals that is invariably fatal once symptoms develop.
- 15. Scabies and other ectoparasites**  
Infections caused by mites, lice or other ectoparasites that can cause intense itching and skin rash.
- 16. Schistosomiasis**  
Trematode (flatworms or flukes) infections transmitted when larval forms released by freshwater snails penetrate human skin during contact with infested water. The adult worms live in the veins draining the urinary tract and intestines, where they can cause damage.
- 17. Snakebite envenoming**  
Bites by venomous snakes that can be fatal.
- 18. Soil-transmitted helminthiasis**  
Nematode (roundworm) infections transmitted through soil contaminated by human faeces causing anaemia, vitamin A deficiency, stunted growth, malnutrition, intestinal obstruction and impaired development.
- 19. Taeniasis and neurocysticercosis**  
An infection caused by adult tapeworms in human intestines; cysticercosis results when humans ingest tapeworm eggs that develop as larvae and form cysts in tissues; neurocysticercosis is the cerebral form with cysts in the brain or spinal cord.
- 20. Trachoma**  
A bacterial (chlamydial) infection transmitted through direct contact with infectious eye or nasal discharge, or through indirect contact with unsafe living conditions and hygiene practices, which left untreated causes irreversible corneal opacities and blindness.
- 21. Yaws**  
A chronic bacterial infection affecting mainly the skin and bone.

## OTHER POVERTY-RELATED DISEASES

- 22. African viral haemorrhagic fevers**  
Zoonotic viral infections, such as Ebola and Marburg, causing haemorrhage (bleeding) and severe multisystem damages, mostly occurring in epidemics.
- 23. Bacterial pneumonia & meningitis**  
Airborne infections of the lungs or of the meninges, the membrane covering the brain, by pneumococcal or meningococcal bacteria, associated with a significant risk of death.
- 24. Cryptococcal meningitis**  
An airborne meningeal infection by a fungus, causing disease in people who have weakened immune systems, particularly those who have advanced HIV & AIDS.
- 25. Diarrheal diseases**  
Infections in the intestinal tract by bacterial, viral or parasitic organisms, spread through contaminated food or drinking-water and causing diarrhoea.
- 26. Hepatitis C**  
A blood borne viral liver infection causing both acute and chronic hepatitis.
- 27. HIV & AIDS**  
The human immunodeficiency virus (HIV) attacks the body's immune system, leading to "immune deficiency", and is fatal if untreated. HIV can be transmitted through unprotected

sexual contact, or significant exposure to infected body fluids (e.g. transfusion of contaminated blood; sharing of contaminated needles). It may also be transmitted between a mother and her infant during pregnancy, childbirth and breastfeeding.

**28. Leptospirosis**

A bacterial infection acquired through direct contact with the urine of infected animals, causing a wide range of symptoms and sometimes leading to serious complications.

**29. Malaria**

A serious and sometimes fatal disease caused by a parasite transmitted through mosquitos. Signs are typically high fevers, shaking chills, and flu-like illness.

**30. Rheumatic fever**

An inflammatory disease that is a complication of a streptococcal throat infection (scarlet fever), and that can affect the heart (rheumatic heart disease), joints, skin, and brain.

**31. Strongyloidiasis**

Chronic parasitic infection by a soil-transmitted roundworm.

**32. Tuberculosis**

A mycobacterial infection that most often affect the lungs, but can attack any part of the body such as the kidney, spine, and brain. Not everyone infected with Tuberculosis (TB) becomes sick and two TB-related conditions exist: latent TB infection and TB disease. If not treated properly, TB disease can be fatal.

**33. Typhoid and paratyphoid fever**

Systemic infections by types of Salmonella bacteria usually acquired through ingestion of contaminated food or water. Acute illness is characterised by prolonged fever, headache, nausea, loss of appetite, and constipation or sometimes diarrhoea.

## Annex 2: Search terms used

### Search terms for young people:

adolescent OR adolescents OR youth OR "young people"

### Search terms for PRNDs:

"neglected tropical diseases" OR "neglected diseases"

dengue

rabies

trachoma

buruli OR "mycobacterium ulcerans"

yaws OR "endemic syphilis"

lepra OR leprosy

"chagas disease" OR "chagas' disease"

trypanosomiasis OR "sleeping sickness"

leishmaniases

taeniasis OR neurocysticercosis OR tapeworm OR cysticercosis

dracunculiasis OR guinea-worm

Echinococcosis OR echinococcus

"foodborne trematodiasis" OR clonorchiasis OR opisthorchiasis OR fascioliasis

filariasis

onchocerciasis OR "river blindness"

schistosomiasis OR bilharziosis

"soil-transmitted helminthiasis" OR "soil-transmitted helminth infection"

mycetoma

chromoblastomycosis OR "deep mycoses"

scabies OR ectoparasites

snakebite

"poverty-related diseases" OR "Infectious diseases of poverty"

HIV OR HIV/AIDS OR "AIDS infection" (review and recent articles only)

tuberculosis (review and recent articles only)

malaria (review and recent articles only)

rotavirus OR cholera OR shigella OR "enterotoxigenic E. Coli" OR ETEC OR cryptosporidium OR

"enteroaggregative E. Coli" OR EAaggEC OR Giardia

"diarrheal diseases"

"bacterial pneumonia" OR "bacterial meningitis" OR S. Pneumoniae OR N. meningitis (review and recent articles only)

hookworm OR ancylostomiasis

"intestinal roundworms" OR strongyloidiasis

whipworm OR trichuriasis

ascaris

"typhoid fever" OR "paratyphoid fever" OR "non-typhoidal S. enterica"

"Hepatitis C" (review and recent articles only)

"Cryptococcal meningitis"

"rheumatic fever"

Leptospirosis

Ebola OR Marburg

