

## Precision health for children and adolescents:

# COMMUNICABLE DISEASES

Collaboration with Harvard Consulting on Business and the Environment

## The Challenge



A child under five dies of malaria nearly **every minute**.<sup>1</sup>



**Diarrhoeal diseases** are one of the leading causes of child mortality, accounting for about 9 per cent of all deaths among children under age 5 worldwide in 2019.<sup>2</sup>



More than 1 million children under 15 years fall ill with **tuberculosis** every year, over half of whom are not diagnosed and/or not reported.<sup>3</sup>



46 per cent of the world's 1.7 million **children living with HIV/AIDS** were not on treatment in 2020.<sup>4</sup>

## Key Takeaways

- Precision medicine is emerging as a crucial tool in the fight against communicable diseases, which are a leading cause of morbidity and mortality among children and adolescents.
- Precision medicine technologies offer potential solutions to prevent, treat and manage malaria, diarrhoeal diseases, pneumonia, and HIV/AIDS.



## Context

Although **precision medicine** is at the early stages of development, results from clinical trials of a few novel treatments seem promising. This brief explores the potential of precision medicine for communicable diseases. Also known as infectious diseases or transmissible diseases, these illnesses are caused by germs (such as bacteria, viruses, fungi, or parasites) that can spread in various ways including through direct physical contact, through the air via coughs or sneezes, contaminated food or water, or through infected vectors like mosquitoes or ticks. Though preventable and curable, children and adolescents are particularly susceptible to life-threatening complications from infectious diseases which present a significant burden on the public health system.

## Malaria

- A life-threatening vector-borne disease that is a significant health issue, particularly for children under five in the African region.
- Climate change and immunological factors increase malaria risk, but precision medicine approaches have shown promise in identifying high-risk individuals and progression pathways.
- The development of the Mosquirix™ vaccine by GlaxoSmithKline and approved by the World Health Organization (WHO) in 2021, marks a major advancement, though its development, supported by machine learning approaches, has been challenging due to the complex genetic variations of the malaria-causing parasite.<sup>5</sup>
- Precision medicine has also played a role in managing malaria, particularly severe malaria in children. By identifying high-risk phenotypes and progression pathways, these approaches have aided in understanding the diversity of clinical presentations and predicting patient outcomes. These advancements are particularly crucial for children with cerebral malaria or respiratory distress, who are at the highest risk of death.<sup>6</sup>

## Diarrhoeal diseases

- There are over 40 pathogens causing diarrhoeal diseases, which remain one of the leading causes of child mortality, particularly in South Asia and sub-Saharan Africa.<sup>7</sup>
- Although affordable protective and preventative interventions are available, precision medicine can aid in identifying these pathogens to monitor variants and tailor prevention and treatments.
- While vaccines exist for some strains, there is no combination vaccine or one for certain strains of *Escherichia coli*.<sup>8</sup>
- Promising research in mice at the Salk Institute for Biological Sciences suggests that a combination of dietary approaches and modified pathogens may create lasting immunity against diarrhoeal diseases, without causing sickness.<sup>9</sup> This result could pave the way for the development of vaccines that promote immunity for people suffering from diarrhoeal diseases.<sup>10</sup>

## Tuberculosis

- Tuberculosis (TB) is a leading cause of death for individuals with HIV and children under 15.<sup>11</sup> It spreads through the air when infected people cough, sneeze, or spit. TB infections are particularly difficult to diagnose in children.
- The emergence of drug-resistant strains of *Mycobacterium tuberculosis* and the limited efficacy of standardized therapies to differences in human immunity or variations in the pathogenesis have slowed progress to eliminate TB by 2030.<sup>12</sup>
- The adoption of precision medicine technologies can improve tuberculosis treatment and management in five areas: sequencing of the mycobacterium tuberculosis genome; directed therapies; tailored antibiotic dosing; monitoring treatment duration, and TB vaccines.<sup>13</sup>

## Pneumonia

- Pneumonia is a form of acute respiratory infection and the leading cause of death among children under 5 years of age.<sup>14</sup> Pre-existing illnesses, such as symptomatic HIV infections and measles, increase a child's risk of contracting pneumonia.<sup>15</sup>
- Differentiating viral from bacterial pneumonia is challenging with traditional diagnostic methods, but the development of novel biomarkers for viral pneumonia using meta-genomics shows promise.<sup>16</sup>
- New biomarkers using meta-genomics can distinguish between viral and bacterial pneumonia, leading to better treatment decisions and reduced antibiotic misuse. A recent study also discovered four new genomic regions associated with pneumonia risk, potentially offering new treatment opportunities, and linking pneumonia risk to possible psychiatric disorders.<sup>17</sup>

## HIV/AIDS

Precision medicine can contribute to prevent and treat HIV/AIDS in at least 3 areas:

- Improve our understanding of pathogenic mechanisms and suggest novel preventive and therapeutic approaches against HIV/AIDS infection.<sup>18</sup>
- Understand immune non-response to antiretroviral therapy which could be due to adverse drug reactions, HIV/AIDS resistance to antiretroviral drugs, and social factors and idiosyncratic characteristics of each patient.<sup>19</sup>
- Discover an HIV/AIDS cure. In 2022, Moderna and IAVI started a Phase 1 clinical trial of an HIV/AIDS vaccine that utilizes Moderna's mRNA technology.<sup>20</sup>

See **Insight Report No. 3** for more information on precision health, including the potential applications of innovations and technologies for the humanitarian and development sector.

## Insights Briefs

**Innovation Nodes Insights Briefs** serve as resource for practitioners and decision makers to quickly get up-to-speed on new and unknown areas of potential innovation for children.

Publication produced by the Innovation Nodes aim to facilitate the exchange of knowledge and stimulate discussion. The findings, interpretations and conclusions

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## Notes

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