

Precision health for children and adolescents:

NON-COMMUNICABLE DISEASES: ASTHMA AND CANCER

Collaboration with Harvard Consulting on Business and the Environment

The Challenge



Disability and mortality burden of non-communicable diseases (NCDs) for adolescents has risen substantially worldwide.¹



It is estimated that more than 2.1 billion children were affected by non-communicable diseases (NCDs) in 2017.²



70 per cent of the premature deaths that occur among adults stem from health-related behaviors that originate in childhood and adolescence.³

Key Takeaways

- The identification of genetic biomarkers in asthma has enabled a better understanding of the physical and functional changes that occur during a disease process, treatment selection and monitoring of treatment.
- Precision medicine technologies have advanced the development of cancer vaccines, including RNA vaccines, and other emerging therapeutic approaches for childhood cancer, including epigenetic approaches, targeting fusion gene products, immunotherapeutic approaches, and microenvironmental therapies.⁴

Context

Addressing non-communicable diseases (NCDs) is a global priority in the Sustainable Development Goals, especially for adolescents. If unaddressed, NCDs have the potential to bring about negative health outcomes, even premature deaths, in adulthood two kinds of non-communicable diseases, asthma (a type of chronic respiratory disease) and cancer. Also known as chronic diseases, they are typically of a long duration and slow progression. Other types of non-communicable diseases are diabetes and cardiovascular diseases.

Asthma

- Asthma symptoms most commonly develop for the first time in early childhood, but no more than half of them go on to have characteristic asthma at school age. Morbidity and mortality have increased significantly in low and middle-income countries (LMICs) due to under-diagnosis and under-treatment.⁵
- Our understanding of childhood asthma has been limited due to the heterogeneity of the asthma subgroups which manifests clinically with variable and poor treatment responses.⁶ However, recent advances in precision medicine using omics sciences and several genome-wide association studies have identified numerous genetic variants involved in asthma susceptibility.⁷
- The identification of genetic biomarkers in asthma has enabled a better understanding of the physical and functional changes that occur during a disease process, the selection of the optimal treatment, and the determination of the efficacy.⁸ This allows for personalized treatment approaches that move beyond the one-size-fits-all model to one that focuses on individual causes of asthma rather than just classifying its type.⁹
- Some scientists anticipate future asthma treatment may shift from a view of 'what type of asthma the patient has' towards 'why the patient has asthma'.¹⁰

Childhood cancer

- Childhood cancers include leukemia, lymphomas, central nervous system tumors, sarcomas of bone and soft tissue, neuroblastoma, retinoblastoma, rhabdoid tumors, liver tumors, renal tumors, germ cell tumors and other rare cancers.¹¹
- The heterogeneity of pediatric malignancies, limited efficacy of targeted drugs, and absence of reliable biomarkers make diagnosis, prognosis, and therapeutic interventions challenging.¹² Childhood tumors often differ from adult cancers, predominantly emerging from embryonic tissue and affecting different cell types.¹³ Moreover, chronic infections like HIV and malaria pose additional risk factors for childhood cancer, especially in LMICs.
- Next-generation RNA sequencing technology, coupled with progress in chromatin and stem cell biology, is paving the way to a better understanding of childhood cancer (Figure 1).¹⁴ RNA sequencing can provide insights into the tumor's expression program, enabling the differentiation of tumors regardless of genomic origin.¹⁵
- **Cancer vaccines**, including RNA vaccines, are under development. However, their clinical efficacy for childhood cancer is not fully known and the cost of such vaccines is expected to be high.¹⁶
- There are other emerging therapeutic approaches for childhood cancer currently in Phase 1 clinical trials, including epigenetic approaches, targeting fusion gene products, immunotherapeutic approaches, and microenvironmental therapies.¹⁷

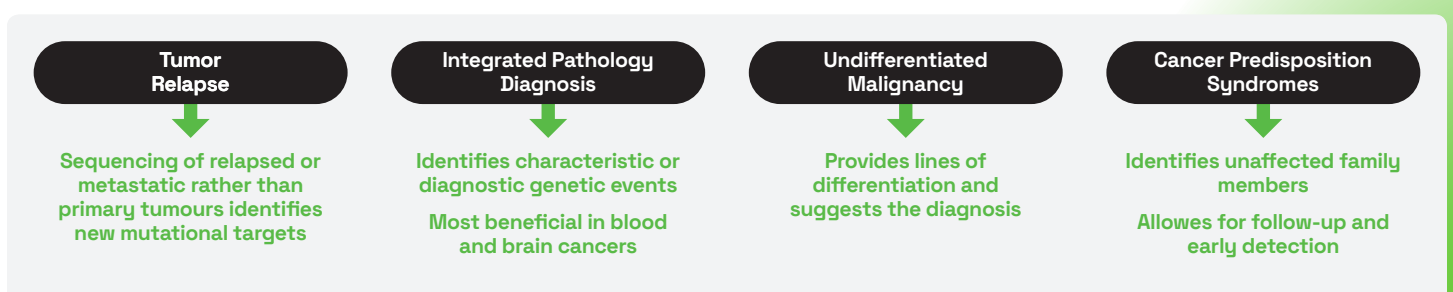


Figure 1: Uses of next-generation sequencing in pediatric cancer

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.

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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.

Notes

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