

ARTICLE COMMENTARY



## Immunization coverage for children with cancer in Latin America and the Caribbean can be improved through strategic coordination of existing global agendas

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### ABSTRACT

Most cases of childhood cancer occur in low- and middle-income countries. In parallel, children with cancer are more vulnerable to infections, including vaccine-preventable infections. We distributed an electronic, self-administered survey to healthcare providers working in Latin America and the Caribbean region who deliver care to children with cancer to assess the factors that influence their decision and ability to vaccinate children with cancer. Our study found that approximately half of respondents consistently requested the patient's vaccination record before starting cancer treatment and that less than 20% estimated that  $\geq 75\%$  of their pediatric patients were up to date on their immunizations. Only a small fraction reported having related government policies and reporting requirements for immunizing/re-immunizing children with cancer. Respondents recognize the need to immunize children with cancer; however, national policies and monitoring tools for this population are lacking. There are global initiatives to address gaps in immunization coverage and to promote the development of policy and infrastructure to support the increasing number of children with cancer. Although they have clear and distinct goals, there are opportunities to combine efforts. Integrating immunizations into national childhood cancer treatment policies and enhancing current vaccination surveillance platforms can address gaps and support an overlooked population.

### KEYWORDS

Childhood cancer; re-immunization; global; Latin America and the Caribbean

### Introduction

Studies estimate that approximately 80% of global childhood cancer cases occur in low- and middle-income countries.<sup>1</sup> Although advances in cancer-directed therapies and treatments have greatly increased survival rates in high-income settings to 80% or greater, depending on the cancer type, survival rates remain as low as 15% in resource-limited settings.<sup>2,3</sup>

Children with cancer are especially vulnerable to infections, including vaccine-preventable infections such as influenza and invasive pneumococcal disease.<sup>4–6</sup> Children in whom cancer is diagnosed may begin treatment without having yet started particular vaccine schedules or miss scheduled doses because of interruptions due to cancer-directed therapies.<sup>7,8</sup> Even if children have completed the entire vaccine series, treatments such as chemotherapy can severely compromise their immune system, resulting in sub-optimal protection.<sup>8–11</sup> Studies have found that chemotherapy-induced immune suppression can cause patients to require more than 6 months to fully recover their immune function, and that the type of vaccine, the type of cancer, and the chemotherapy regimen can all affect a patient's antibody levels after their immunity has recovered.<sup>12</sup>

Efforts over the past decade have been effective in increasing coverage for vaccine-preventable diseases in children

worldwide, but gaps remain,<sup>13</sup> with most unvaccinated children living in middle-income countries.<sup>14</sup> Moreover, recent years have seen declines in immunization coverage due to misinformation, conflict, or disruptions to care resulting from the COVID-19 pandemic.<sup>15</sup> A 2022 UNICEF progress report comments that although coverage rates are slowly increasing, they remain lower overall than in 2019, with approximately 84% coverage for the third dose of diphtheria – tetanus – pertussis immunization (DTP-3) (a marker of overall immunization coverage) in 2022, as compared to 86% in 2019 and 81% in 2021.<sup>16</sup> Immunization schedules have been developed by and are available from organizations such as the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), and the Advisory Committee on Immunization Practices (ACIP) in the United States, and national immunization committees in many countries have developed guidelines to support the recommended delivery of all essential childhood primary immunizations from birth to 18 years of age, offering recommendations for catch-up or additional doses for special populations such as children with cancer.<sup>17–23</sup> It is currently unclear, however, what proportion of children with cancer receive their indicated catch-up doses or whether they receive additional or booster doses after completing cancer-directed treatment to restore their immunity to optimal levels.<sup>24</sup>

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Although countries report national childhood immunization data to the WHO/UNICEF Joint Reporting platform, there is no evidence that immunization coverage of children with cancer is detailed.<sup>25,26</sup> Children who have completed cancer treatments eventually return to their communities and schools, where having protection against communicable diseases is essential but suboptimal immunity leaves them susceptible to infection. Children who have completed cancer treatment, no matter their immunization status beforehand, can have lower-than-ideal immunity against many vaccine-preventable infections, such as tetanus, pertussis, diphtheria, and pneumonia, as a consequence of the immunosuppressive therapies of cancer treatment and the interruptions to standard care during their treatment.<sup>8,9,27</sup> In a multicenter trial of children with acute lymphoblastic leukemia (ALL),<sup>8</sup> children who had completed chemotherapy regimens were less likely than controls to be up to date on their immunization schedules, had lower antibody levels against a multitude of vaccine-preventable infectious pathogens, and in some cases had no detectable immune responses to some pathogens. Their antibody levels, however, could be restored to protective levels with appropriate catch-up immunizations and/or boosters.

Although vaccination coverage has been rising since early 2000,<sup>16</sup> the Latin America and Caribbean region has faced a steady decline over the past 10 years, with 93% DTP-3 coverage in 2010, as compared to 71% coverage in 2022.<sup>28,29</sup> As a result of this decline, exacerbated by the negative impact on vaccination coverage of the COVID-19 pandemic, coverage has not yet rebounded to 2019 levels.<sup>15</sup> Additionally, WHO/UNICEF Estimates of National Immunization Coverage (WUENIC) found that low- and middle-income countries experienced more severe backsliding in vaccination coverage for children than did high-income countries. This inevitably creates an environment in which communities are more susceptible to vaccine-preventable infections, thereby posing a continued risk to children who have completed cancer treatment and have returned to these same communities. Moreover, the gradual decrease in the population coverage of essential vaccines not only globally but in the region has created an environment in which vaccine-preventable infections are more likely to circulate, rendering those individuals with suboptimal antibody levels more susceptible to contracting these infections.

The issue of vaccination coverage levels for children with cancer is missing from the global dialogue on achieving ideal immunization coverage worldwide. The 2022 WUENIC report on progress and challenges in reaching targeted immunization coverage worldwide focuses on zero-dose children, i.e., those who have not received any doses of a particular vaccine schedule, and under-vaccinated children, i.e., those who have not completed a vaccine schedule that requires multiple doses, as with DTP-3 for diphtheria – tetanus – pertussis coverage.<sup>15</sup> Therefore, there remains a data gap wherein children who have completed cancer-directed treatment are overlooked. If they completed a three-dose schedule before starting cancer treatment, they are technically considered to have attained ideal vaccination coverage, according to the UNICEF measures, whereas in reality a booster (i.e., a fourth dose) is highly recommended for these children; otherwise, ideal immunity

levels cannot be assured.<sup>8,9,15,27</sup> Similarly, although funding of childhood immunization programs is a cornerstone of the global discussions on improving vaccination rates worldwide, funding dedicated to the extra doses needed by children who have completed cancer treatment is not discussed.<sup>30,31</sup>

A key element in ensuring vaccine coverage for this population is understanding whether healthcare providers caring for children with cancer in the region are willing to vaccinate this special population, how they prioritize this element in the totality of care for a child with cancer, and what resources are available to support their decision-making. Managing care for a child with cancer is a multidisciplinary undertaking, and ensuring coverage for childhood immunization requires many types of specialists to have access to the information and resources necessary to appropriately recommend and vaccinate a child with cancer. As this special population is excluded from the global discourse on vaccination coverage and as the resources available to support vaccinating this population are not currently well described, we sought to characterize the context in which healthcare providers in Latin America and the Caribbean are working, specifically as it relates to the availability of national policies, clinical guidelines and tools, and the government funding that currently exists to support immunizing children with cancer and to identify gaps and opportunities for strengthening coverage.

## Materials and methods

We previously conducted a self-administered cross-sectional survey among healthcare providers in Latin America and the Caribbean to gain a better understanding of vaccination practices for children with cancer in the region and to identify feasible and appropriate strategies for best care in this context.<sup>32</sup> Participants included hematologists/oncologists, infectious disease specialists, pediatricians, nurses, and other medical specialists and allied health professionals. The electronic survey was distributed through a contact list of healthcare professionals working in childhood cancer in the region in collaboration with the Department of Global Pediatric Medicine at St. Jude Children's Research Hospital.

The survey items were constructed using the Consolidated Framework for Implementation Research<sup>33</sup> domains and constructs to identify healthcare providers' roles in vaccinating children with cancer in the region, including factors at the institutional, national, and international level that may affect the practice of vaccinating children with cancer. Specifically, participants were asked about the availability of guiding documents from their governments, whether written policies or clinical guidelines, the availability of funding for vaccinating children and children with cancer, and any reporting requirements when immunizing children with cancer. The survey was available in English, Latin American Spanish, French, and Brazilian Portuguese.

The survey was distributed to 3236 unique e-mail addresses and was open to responses for 25 days. A total of 384 completed surveys were received and were included in the analysis. After data cleaning, four responses were excluded because the

respondents were exclusively non – patient centered (e.g., they were involved in clinical research) and two responses were excluded because a high proportion of questions were skipped. Therefore, a total of 378 participant responses were included in the final analysis.

## Results

### Demographics

We received responses that represented experiences from 20 countries in the Latin America and Caribbean region, with most respondents working in upper-middle-income settings ( $n = 302$ , 79.9%) and in institutions in urban settings ( $n = 371$ , 98.1%). Most respondents were hematologist-oncologists ( $n = 143$ , 37.8%), infectious disease specialists ( $n = 77$ , 20.4%), or pediatricians ( $n = 38$ , 10.1%). Other respondents ( $n = 120$ , 31.7%) represented various specialties in nursing, infection prevention and control, other medical subspecialties, allied health professions, and health and hospital administration and leadership.

### Vaccination status

Participants were asked to estimate the percentage of their pediatric patients with cancer who were up to date on the recommended childhood immunizations. Responses were fairly evenly distributed (Table 1): Only 19.1% ( $n = 72$ ) believed that  $\geq 76\%$  of their patients were appropriately up to date on their immunizations, whereas more than half ( $n = 219$ , 58%) believed the proportion to be less than 50% or were unsure. Participants were asked whether requesting vaccination history before starting treatment was part of the practice at the institutions where they worked. Only approximately half of the respondents ( $n = 181$ , 48.0%) reported working in an institution where patients are always asked for their vaccination card/vaccination record before beginning cancer-directed treatment, 24.9% ( $n = 94$ ) reported asking for it sometimes, whereas the remainder did not ask ( $n = 57$ , 15.1%) or were unsure ( $n = 45$ , 11.9%). Nearly three-quarters of respondents ( $n = 275$ , 72.8%) work in institutions where patients, at least sometimes, are asked for a record of their vaccination history before starting cancer treatment.

Most respondents ( $n = 321$ , 84.9%) reported recommending vaccines to their patients. However, if a patient had completed a primary course of immunizations before receiving chemotherapy, many respondents ( $n = 181$ , 47.9%) would not repeat any primary immunizations after treatment, whereas others would administer a single booster ( $n = 153$ , 40.5%) or

**Table 2.** Distribution of prioritization for keeping a pediatric patient with cancer up to date on childhood immunizations by respondent specialty ( $n = 377$ ).

	Essential, high or medium priority, n (%)	Low or not a priority at all, n (%)	Total
Hematologist-oncologists	122 (85.9)	20 (14.1)	142
Infectious disease specialists	68 (88.3)	9 (11.7)	77
Pediatricians	32 (84.2)	6 (15.8)	38
Other providers	104 (86.7)	16 (13.3)	120

One survey respondent did not respond to this question.

re-complete the entire primary course ( $n = 43$ , 11.4%). Responses were nearly evenly split on whether the intensity of chemotherapy affected the decision on whether to re-immunize a patient: 190 (50.5%) said it did; 186 (49.5%) said it did not.

When asked to consider how much they prioritized keeping a pediatric patient with cancer up to date on childhood immunizations within the totality of care for that child, most ( $n = 326$ , 86.2%) agreed that this was a priority, whether essential, a high priority, or a medium priority. Only 51 (13.5%) reported that this was a low priority or not a priority at all. There was no significant difference in responses according to the respondent's role in the patient's care; respondents in all categories were equally more likely to rate it a priority (Table 2).

### Vaccination guidance

Participants responded to questions regarding vaccination policies and vaccination guidelines available to them in their practice, where policies reflect required actions related to vaccinating children and children with cancer and guidelines reflect suggestions for clinical decision making.

The 247 respondents (65.3%) who reported using a vaccination guideline or clinical decision tool to help plan the vaccination of a pediatric patient with cancer were asked to select which guidelines they used in their practice, with the ability to choose more than one. The most frequently referenced guideline was the CDC immunization schedule ( $n = 104$ , 42.4%), followed by the WHO immunization schedule ( $n = 86$ , 35.1%), and then a governmental guide ( $n = 64$ , 26.1%) (Table 3).

Survey participants were asked to report on the availability of national immunization policies (required practices in patient care) and national guidelines for immunizing patients (recommended practices to support clinical decision making). Only 18% of participants ( $n = 67$ ) reported that their national governments published written policies regarding vaccinating children with cancer, whereas 58% ( $n = 220$ ) said they did not and 24% ( $n = 91$ ) were unsure. A similar trend was reported for clinical guidelines for vaccinating children with cancer: 19.6% ( $n = 74$ ) said their governments published clinical guidelines for this, 9.5% ( $n = 187$ ) said their governments did not, and 31% ( $n = 117$ ) were unsure.

Participants were also asked whether they had reporting requirements for childhood immunizations, and most ( $n = 234$ , 61.9%) reported that they did; however, of those with reporting requirements, 49.1% ( $n = 68$ ) reported that these did not include a requirement to report immunization/re-

**Table 1.** Estimated percentage of pediatric patients with cancer at your hospital who are up to date on recommended childhood immunizations ( $n = 377$ ).

Percent coverage	n, %
$\geq 76\%$	72, 19.1%
51–75%	87, 23.1%
26–50%	82, 21.7%
$\leq 25\%$	72, 19.1%
I'm not sure	65, 17.2%

One participant did not respond to this question.

**Table 3.** Distribution of guide or clinical decision tool used to support decision making by survey respondents ( $n = 247$ ).

Guide or Clinical Decision Tool	Selected, $n$ (%)
Centers for Disease Control and Prevention (CDC)	104 (42.4)
World Health Organization (WHO)	86 (35.1)
Local government	64 (26.1)
Infectious Disease Society of America (IDSA)	60 (24.5)
Sociedad Latinoamericana de Infectología Pediátrica (SLIPE)	41 (16.7)
Local pediatric society	38 (15.5)
Institution/hospital	37 (15.1)
Other	16 (6.5)

Two participants who answered yes did not respond to this question. The count of selected guides and tools is greater than 247 because participants were allowed to select more than one guide. Similarly, the percentages add to more than 100% as a result of participants selecting more than one guide or tool.

immunization of pediatric patients with cancer. Also, whereas most participants ( $n = 345$ , 91.3%) practice in countries where the government provides funding for immunizing children, only half ( $n = 183$ , 48.5%) reported that funding was specifically available for re-immunizing children with cancer.

## Discussion

Our survey sought to assess the roles of these providers in immunizing children with cancer and the factors that influenced their decision and their ability to vaccinate children with cancer. Though based on a convenience sample of providers who are engaged with our institution, these responses illuminate a baseline of factors that can serve as a starting point for realizing change. Only approximately half of the respondents consistently requested the patient's vaccination record before starting cancer treatment at their institutions. Moreover, less than 20% estimated that  $\geq 75\%$  of their pediatric patients were up to date on their immunizations, indicating that many pediatric patients with cancer are likely under vaccinated and not sufficiently protected against vaccine-preventable infections, a major risk for morbidity and mortality during cancer-directed treatment.<sup>4-6</sup> Many respondents reported using at least one clinical guideline or decision-tool to support their decision making for vaccination of children with cancer, with most referring to the CDC schedule and only one-quarter following a guideline developed by their government. Furthermore, only a small fraction reported having government policies related to vaccinating children and reporting requirements for immunizing/re-immunizing children with cancer, whereas substantially more reported having funding available specifically for vaccinating children with cancer. Though the CDC schedule can be universally applied, the guidance provided for children with cancer is minimal and lacks detailed decision-making support for local context, like vaccine availability, endemic disease risks, and local laws and policy.

Most survey respondents believed that keeping their patients with cancer up to date on their immunizations was an important component cancer care, but this was not entirely reflected in practice. There was a clear disconnect between prioritizing a patient remaining up to date on vaccinations versus ensuring that the patient regained optimal immune protection after completing treatment. Many respondents appeared to lack the resources needed to enable appropriate immunization of these

patients, whether this was related to not knowing a patient's vaccination history before starting cancer treatment, to a paucity of governmental policies and guidelines to support clinical decision making, or to inadequate funding for re-immunizing children with cancer once they have completed treatment.

There was also an apparent difference in experiences not only across the region but within countries. Whereas some participants shared comments about having specialized teams or infectious disease specialists review vaccine records and prescribe vaccines for patients with cancer, others reported practicing in hospitals where oncologists did not consider indications for immunizations in their patients. Some participants shared their desires to have national guidelines or protocols to guide this practice, whereas one participant reported working in a country with existing vaccination policies that did not account for the need to adapt schedules for particular vaccines (e.g., against *Hemophilus influenzae* type B or meningococcal C infection) for children with cancer who missed these vaccines as a consequence of cancer treatments.

These findings reflect a gap for practicing healthcare providers in the region that can be addressed through national policies. Although guidelines can support clinical decision making, they will not change practice sufficiently unless national policies are put in place. A policy would guide the immunization of this special population, requiring providers to ensure that catch-up immunizations are given or that boosters are a part of care after cancer treatment and would address two key concerns recognized by participants of this survey: lack of patient vaccine history and lack of funding for re-immunization and booster doses for children with cancer. The CDC Advisory Committee on Immunization Practices recommends administering recommended vaccines to patients with incomplete or unknown immunization histories.<sup>34</sup> Moreover, there is no evidence that receiving an extra dose of a particular antigen is significantly harmful.<sup>35</sup> This should encourage providers to recommend booster doses to their patients no matter the availability of vaccine histories. Incorporating this into a national policy would then go further and require this practice, in turn improving vaccine coverage through governmental support for a healthcare intervention that healthcare providers support. Moreover, if funding for the additional doses that children with cancer require is currently unavailable, the creation of a national policy should require the allocation of funds to meet this policy's expectations. Allocating funding will bolster the requirement of delivering re-immunization and booster doses to children with cancer, ensuring that patient families are not burdened with the cost of recovering immune protection after cancer treatments. Addressing this gap will require expanding the conversation on vaccinating children with cancer beyond the pediatric oncology environment, working with local healthcare providers and national governments to implement policies that support the vaccination of this special population, and the continued use of data to expand our understanding of vaccination coverage for this population, all of which are aligned with the four core principles of the WHO Immunization Agenda 2030.

The WHO Immunization Agenda 2030 is an initiative aimed at implementing a framework to encourage and

## WHO Immunization Agenda 2030 Strategic Priorities

- 1 Strengthen immunization services and programs as part of primary care and universal health coverage.
- 2 Foster commitment to ensuring immunization is valued and prioritized by all.
- 3 Ensure equitable and full immunization coverage for all.
- 4 Expand immunization services across health service and throughout the life course.
- 5 Detect and respond to vaccine- preventable outbreaks and during emergencies.
- 6 Support reliable supply of appropriate, affordable, and quality vaccines for all alongside stable financing.
- 7 Promote innovation and research to increase reach of immunization programs for all.

*Adapted from the WHO Immunization Agenda 2030<sup>35</sup>*

**Figure 1.** World Health Organization Immunization Agenda 2030 strategic priorities.

increase vaccination coverage for all children worldwide. This initiative is guided by four core principles: it is people-centered to respond to population needs, it is implemented with partnership-based alignment across sectors, its progress is country-owned and driven, and it is data-guided to promote evidence-based decision making. This agenda comprises seven strategic priorities that are intended to address gaps in immunization, such as through healthcare delivery, policy making, and innovation and research (Figure 1).

In particular, the fourth strategic priority focuses on life-course and integration, with the goal to have “all people benefit from recommended immunizations throughout the life course, effectively integrated with other essential health services” through the objectives of strengthening

immunization policies that specifically address catch-up vaccinations and booster doses.<sup>36</sup> Although incorporating children with cancer into the immunization agenda will benefit multiple strategic priorities, this key population would especially benefit from being included in the dialogue for strategic priority four (Box 1). The foci of the WHO for this strategic priority include mobilizing support, integrating immunization into other healthcare interactions to address missed immunization opportunities, promoting policies at the national level to address this gap, and tracking vaccination status to monitor coverage for atypical populations (i.e., not the standard childhood vaccination schedule), thereby addressing the needs shared by many of the survey respondents as well as supporting the aims of the WHO agenda.

**Box 1.** World Health Organization Immunization Agenda Strategic Priority 4: All people effectively integrated with other essential health services.

WHO key area of focus	Recommendation
Mobilize support: raise awareness of vaccination benefits beyond early childhood through other ages and priority groups	Capitalize on existing prioritization by healthcare providers for keeping children with cancer up to date on vaccinations to raise awareness at the national level
Address missed opportunities: implement approaches to reduce missed opportunities and integrate immunization into other health system exposures	Create integral catch-up opportunities during children with cancer's healthcare visits as institutional and national recommendations rather than provider suggestions
Improve policy environment: promote changes in national immunization legislation or policy beyond early childhood	Harmonize efforts with the Global Initiative for Childhood Cancer to work with the CureAll Framework to incorporate immunizations as part of essential medicines
Track vaccination status: monitor vaccination coverage throughout the life-course	Leverage existing immunization reporting available in countries to include children with cancer vaccination status, whether catch-up or additional booster doses

*Adapted from the WHO Immunization Agenda 2030.<sup>36</sup>*

### ***Mobilizing support***

To mobilize support, the WHO seeks to raise awareness of the benefits of vaccinating beyond early childhood through adolescence and including other priority groups. Children with cancer should be included as part of this effort. Most of our study respondents reported that keeping children with cancer up to date with their immunizations was a priority. This reflects an existing awareness of the benefits of vaccination for this population and a desire to include it in the care delivery for children with cancer by all healthcare providers involved. Although vaccinating children with cancer is prioritized by various healthcare providers, they appear to perceive a lack of prioritization and support from their governments. To protect these patients effectively and attain the WHO goals by 2030, we have the opportunity to capitalize on the existing support from providers and encourage governments to include children with cancer in the discussions regarding achieving ideal vaccination coverage.

### ***Addressing missed opportunities***

The WHO is also focusing on implementing strategies to reduce the number of missed vaccination opportunities by integrating and streamlining immunization across the health system. Children with cancer have frequent exposures to the healthcare system through their visits for cancer treatment, monitoring, and follow-up. The American Academy of Pediatrics and the Advisory Committee for Immunization Practices recommend taking advantage of healthcare visits, and especially hospital visits, to increase immunization rates for pediatric patients.<sup>37,38</sup> Although the timing of vaccinations for children with cancer needs to be considered, their extended exposure to the healthcare system creates an opportunity to coordinate immunization across multiple providers and address missed opportunities for catch-up immunizations and boosters, where necessary.

### ***Promoting national policies***

A key focus of the WHO Immunization Agenda is promoting legislation that extends immunization programming beyond its current status as solely part of early childcare and forms new collaborations. Survey respondents reported working in a context with a lack of governmental policies or guidelines to ensure that children who have completed cancer treatment have the expected and necessary immune protection against vaccine-preventable infections. Although many respondents referred to global guidelines, such as those from the CDC or the WHO, national guidelines would provide more specific and applicable guidance in the local context, especially for endemic diseases, such as yellow fever, and would consider local vaccine availability. Contextualizing this guidance into national policy demonstrates the government's recognition of the importance of vaccinating children with cancer, incorporates a legal requirement to provide this component of care, and establishes a foundation for allocating funding to support vaccinating this special population. This contextualization supports healthcare providers in their efforts to prescribe and

deliver the necessary vaccines, including boosters, to children who have undergone cancer treatment, and it fulfills the efforts of the WHO to expand the discourse on immunization.

Herein lies an opportunity to harmonize with another WHO agenda, the Global Initiative for Childhood Cancer (GICC), which has been working toward integrating childhood cancer prioritization at the global, regional, and national levels since 2018, working extensively in the area of policy and capacity building. This initiative has been working closely with Ministries of Health to increase the prioritization of childhood cancer treatment at the governmental level. Twenty-one countries in the region have already engaged with the CureAll initiative, whether formally or informally.<sup>39</sup> There is an opportunity to incorporate immunization into these conversations and to promote this component of patient care into national policy. The WHO GICC operates through a CureAll framework, with the *r* representing “Regimens for management,” meaning that it prioritizes developing national standards of care and focuses on ensuring a reliable supply of high-quality medicines.<sup>40</sup>

The WHO Childhood cancer care pathway comprises four stages: early detection, diagnosis, treatment and palliative care, and survivorship.<sup>39</sup> Infection care and prevention plays a vital role in the treatment and survivorship stages, constituting an element of supportive care (disciplines that focus on preventing, addressing, and alleviating the side-effects of cancer treatments). Immunization in particular is a proven safe, cheap, and effective method of infection prevention and control.<sup>40</sup> Because the GICC is promoting and participating in active conversations with national governments to support policy-making for childhood cancers, including language that lays out policy and subsequent funding for immunizing children with cancer not only takes advantage of the ongoing work in this field but enables both the Immunization Agenda 2030 and the GICC to work symbiotically to achieve their goals.

### ***Tracking vaccinations***

Finally, the WHO recommends implementing policies for monitoring vaccination at any age and throughout the life course. Most participants reported a requirement for government reporting of childhood immunizations across all countries included in the survey. However, many fewer reported such tracking for immunization of children with cancer. Given that the infrastructure already exists across all countries that can monitor vaccination coverage for children, these information systems can be leveraged to include the tracking of vaccination status for children. Instituting policies that require such reporting will result in better information on patient vaccination history and current immune for healthcare providers use in managing the treatment of these patients as well as in more accurate descriptions of vaccination coverage across populations.

### ***Conclusion***

Awareness of the benefits and prioritization of immunizing children with cancer exists among healthcare providers in the Latin America and the Caribbean region; however,

national policies and monitoring tools to ensure immunizations for this population are lacking. Immunization is a cost-effective and well-proven strategy for preventing infections in the population, including among children with cancer. Two global initiatives aim to address the gaps in immunization coverage (WHO Immunization Agenda 2030) and to promote the development of policy and infrastructure to support the increasing number of children with cancer (WHO GICC). Although the two initiatives have clear and distinct goals, they share interests and opportunities to use their combined efforts to support this special population. Integrating immunizations into written childhood cancer treatment policies at the national level and enhancing current vaccination surveillance platforms to include children with cancer can address this gap and support an overlooked population that is susceptible to vaccine-preventable infections. Though this has not yet been done in the region, we hope to demonstrate the feasibility of this approach by working with key GICC countries in the region to include immunization priorities in their agendas.

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## Author contributions

CRedit: **Maysam R. Homsy**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing; **Carol Underwood**: Conceptualization, Methodology, Supervision, Writing – review & editing; **Miguel A. Caniza**: Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing; **Melissa A. Davey-Rothwell**: Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing.

## Disclosure statement

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## Ethical approval

This study was approved as an exempt study by the Institutional Review Board of St. Jude Children's Research Hospital (reference: 018772).

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