Child's Nervous System (2019) 35:257–265
https://doi.org/10.1007/s00381-018-4000-x

ORIGINAL PAPER

The Latin American Brain Tumor Board teleconference: results of a web-based survey to evaluate participant experience utilizing this resource

Mohammad H. Abu Arja[1] · Joseph R. Stanek[1] · Andrés E. Morales La Madrid[2] · Alvaro Lassaletta[3] · Ute Bartels[4] · Ibrahim Qaddoumi[5] · Jonathan L. Finlay[1] · Diana S. Osorio[1]

Received: 27 September 2018 / Accepted: 1 November 2018 / Published online: 14 November 2018

Abstract

Purpose The Latin American Brain Tumor Board (LATB) is a weekly teleconference connecting pediatric neuro-oncologists from referral centers in high-income countries with pediatric subspecialists from 20 Latin American countries since 2013. This survey explored the participants' experience utilizing this resource.

Methods A cross-sectional electronic questionnaire was distributed to 159 participants through email and Cure4Kids.

Results Ninety-five respondents (60%) from all the participating countries completed the survey. Sixty-one reported frequent-attendance (≥ 1 per month), 23 reported infrequent-attendance (< 1 per month), and 11 never participated. The most frequently reported attendance-barriers were the subspecialist's workload (64%), the timing of the teleconference (38%), and Internet connectivity problems (29%). Subspecialist's workload was more frequently reported as a barrier compared with other barriers, in both the frequent- and infrequent-attendance groups ($p < 0.05$), with the exception of the timing of the meeting in the infrequent-attendance group. More than 80% of attendees found the frequency and duration of the teleconference were sufficient. Utilizing Spanish as the primary language was reported to enhance the recommendations by 93% of the attendees. Moreover, 84% reported that the recommendations (almost) always fit the local circumstances. Furthermore, 99% of attendees found the teleconference provided a continuing medical education opportunity. Finally, 96% of attendees (almost) always found that the provided recommendations helped to improve the outcomes/quality of life of the patients.

Conclusions The LATB teleconference provided a valuable tool for the management of pediatric brain tumors in Latin America as it provided a feasible and easy to access continued medical education opportunity for the participants.

Keywords Childhood brain tumors · Central nervous system tumors · Global oncology · Lower and middle income countries · Neuro-oncology · Telemedicine

This manuscript was presented at the International Symposium on Pediatric Neuro-Oncology held in Denver, Colorado on July 1st, 2018.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00381-018-4000-x) contains supplementary material, which is available to authorized users.

✉ Diana S. Osorio
Diana.Osorio@nationwidechildrens.org

[1] The Department of Hematology, Oncology, Blood and Marrow Transplant, Nationwide Children's Hospital and The Ohio State University, 700 Children's Drive, Columbus, OH 43205, USA

[2] The Department of Hematology and Oncology, Hospital Sant Joan de Déu, Barcelona, Spain

[3] The Pediatric Oncology, Hematology and Stem Cell Transplant Department, Hospital Infantil Universitario Niño Jesús, Madrid, Spain

[4] The Department of Hematology Oncology, Hospital for Sick Children, Toronto, Canada

[5] Global Pediatric Medicine Department, St. Jude Children's Research Hospital, Memphis, TN, USA

Introduction

Eighty percent of the 200,000 children diagnosed with cancer annually worldwide reside in low- and middle-income countries (LMIC) [1, 2]. In contrast to high-income countries (HIC) where 80% of children diagnosed with cancer are surviving, children with cancer in LMIC have limited access to treatment and lower cure rates [1–3].

Central nervous system (CNS) cancers are the second most common pediatric malignancy after leukemia worldwide [4]. Pediatric CNS cancer is the leading cause of cancer-related childhood mortality in the USA [5]. The population of Latin American countries is younger than HIC as 25% of the population is below 14 years of age compared with 19% in North America [6]. Therefore, the burden of Pediatric CNS cancer is expected to increase in Latin America, especially with continuing improvements in public health that decrease infant and childhood mortality associated with malnutrition and infection [4, 7–9]. However, delivering effective pediatric neuro-oncology medical care relies on the availability of numerous pediatric subspecialties, ancillary staff, and costly physical and infrastructure resources [8]. Therefore, the capacity of LMIC in Latin America to reduce the burden of CNS cancer among their children is limited by the complex nature of pediatric neuro-oncology.

The majority of oncologists in Latin America are not subspecialized. They serve a diverse population of children with often complex hematological and oncological diseases. Therefore, the responsibility to keep apprised of advanced treatment options and the latest research for patients with a wide variety of conditions including brain tumors is a daunting task. Moreover, the medical literature is primarily written in English and accessible via costly journal subscriptions that may not be available in some institutions. Additionally, the delivery of effective neuro-oncology care needs a strong multi-disciplinary effort, which is lacking as well.

The Latin American Brain Tumor Board (LATB) teleconference was piloted in August 2013 with the aim to address the previously mentioned challenges. This effort has since grown to connect six global pediatric neuro-oncologists from children's hospitals and cancer centers in the USA, Canada, and Spain with pediatric subspecialists from 20 Latin American countries[1] (Fig. 1). Accordingly, the LATB aims to both provide support and education and promote a multi-disciplinary approach, second pathology, and radiology reviews in addition to medical care recommendations that accommodate to the local conditions of the participating institutions.

[1] The six-global pediatric neuro-oncologists are from the following institutions: Hospital for Sick Children (Canada), St. Jude Children's Research Hospital (USA), Hospital Sant Joan de Déu (Spain), Hospital Infantil Universitario Niño Jesús (Spain), and Nationwide Children's Hospital (USA).

The LATB is a real-time, web-based, 1-hour weekly teleconference that is held every Monday. Prior to the sessions, participants from Latin America prepare and submit presentations of cases they want to be reviewed by the six global pediatric neuro-oncologists for a recommendation of care. Each session is limited to up to four cases to provide sufficient time for detailed discussion. Upon review of the cases, we select specific cases that would benefit from a second pathology review either at Nationwide Children's Hospital or St. Jude Children's Research Hospital. The session is conducted in Spanish utilizing St. Jude Children's Research Hospital's Cure4Kids online platform. Finally, meeting summary reports (minutes) are sent after each session in Spanish to all members regardless of their participation to distribute and solidify the recommendations provided.

As this program continued to show increasing participation, we collected participants' feedback on various processes of the LATB to provide an evaluation process of the teleconference with the aim to improve the participants' utilization of this tool and the sustainability of such intervention [10–12]. Therefore, we developed a web-based survey to objectively evaluate our program. The survey focused on various processes of the teleconference that may affect attendees' experience utilizing this tool; however, it was not aiming to measure the change in patients' outcomes prior and post-implementation of LATB.

In this report, we highlighted the strengths and weaknesses of various processes of the LATB teleconference, with the hopes of improving our program and provide guidance for designing and implementing future similar global oncology telemedicine interventions.

Methods

The cross-sectional electronic survey was approved by the institutional review board (IRB) at Nationwide Children's Hospital. A Google Forms platform was used to design a web-based questionnaire. The survey included 17 core questions to evaluate the participants' feedback on various components of the program (Online Resource 1). The questions were reviewed by the six global pediatric neuro-oncologists from the partner sites mentioned above. The questions were translated into Spanish and distributed to 159 participants from 20 Latin American countries using their emails and the Cure4Kids platform. The 159 participants from Latin America are predominantly pediatric hematologists/oncologists ($n = 112$) (Table 1).

Data were collected from December 2017 to January 2018. To increase participation, reminders were sent to all eligible participants 1, 2, and 4 weeks after the initial request. Participation in the survey was optional and no personal identifying information was collected. The need to obtain a signed consent to participate in the study was waived by the Nationwide Children's Hospital IRB. Study personnel utilized standard measures to protect confidentiality. All data were

Fig. 1 Map displaying countries with Latin American Brain Tumor Board participants

stored online via a password protected form in Google Forms and password protected Microsoft Excel sheet.

Survey responses were analyzed using descriptive statistics. The respondents were stratified on the basis of their attendance frequency. Frequent-attendance group were defined as respondents who participated at least once per month in the LATB teleconference. Infrequent-attendance group were defined as respondents who participated less than once per month. Respondents who never participated in the program were classified as a never-attendance group. The responses of the never-attendance group were only included in the analysis of the barriers and limitations to attend the teleconference and the LATB post-teleconference summary reports, and otherwise were excluded from the evaluation of the other processes of the teleconference. "Participants" refers to all members of the LATB in Latin America who were invited to fill out the survey ($n = 159$). "Respondents" refers to all members of who completed the survey regardless of their attendance frequency ($n = 95$). "Attendees" refers to respondents of the survey who at least participated once in the teleconference ($n = 84$). Differences in survey responses between respondents with frequent- and infrequent- attendance were analyzed using chi-square or Fisher's exact tests. All statistical analyses were performed using the base R statistical package (R Foundation for Statistical Computing, Vienna, Austria).

Table 1 Participating subspecialties in the Latin American Brain Tumor Board

Sub-specialty	Number (%) of participants
Neuro-oncology	2 (1)
Pediatric hematology and oncology	112 (70)
Neurosurgery	10 (6)
Pathology	5 (3)
General pediatrics	4 (3)
Radiation oncology	4 (3)
Radiology	3 (2)
Trainee (resident/fellow)	11 (7)
Other non-physician clinical staff	8 (5)
Child-life therapist	4
Nurse	1
Applied pediatric oncology scientist	1
Oncology service admin. coordinator	1
Not specified	1

Data availability All data generated or analyzed during this study are included in this published article and its supplementary information files.

Results

Ninety-five members of the LATB from Latin America completed the survey (60% response rate). Responses were collected from all 20 countries participating in LATB (Fig. 2). Sixty-one respondents reported frequent-attendance: 21 reported a weekly attendance, 25 reported a bi-weekly attendance, and

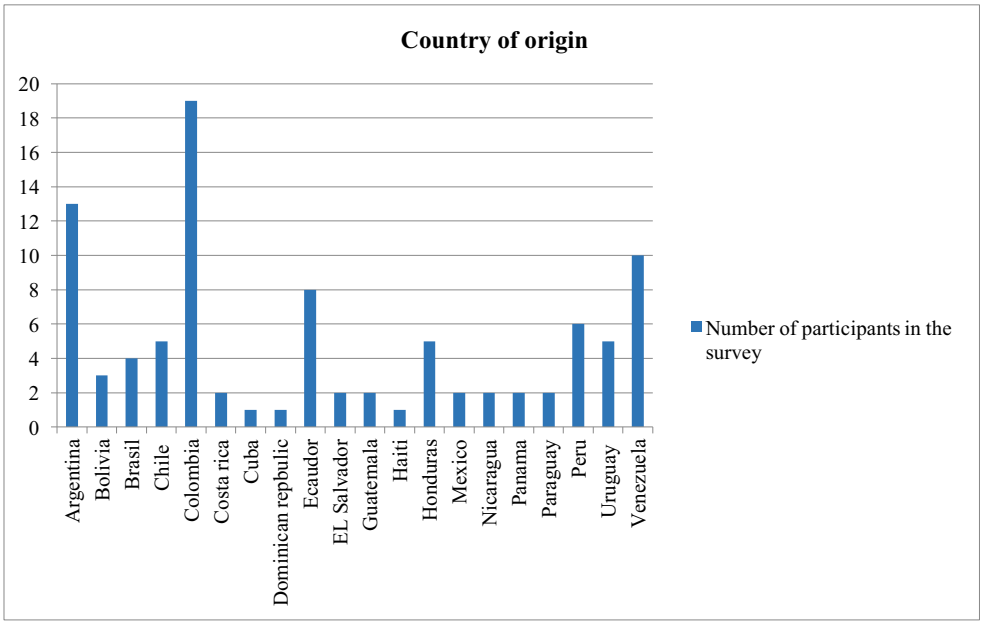

Fig. 2 Participants' country of origin

15 participated once a month. Twenty-three respondents reported infrequent-attendance: four participated once in 3 months, 19 participated once or twice only, and 11 of the respondents have never participated in the teleconference.

Teleconference attendance barriers

Ten respondents reported no attendance limitations. The most frequently reported attendance barriers were the physicians' workload (64%), the timing of the teleconference (38%), and Internet and accessing Cure4Kids problems (29%) (Fig. 3). The infrequent-attendance and never-attendance groups reported all attendance barriers more frequently compared with the frequent-attendance group except for Internet and accessing Cure4Kids problems (Fig. 3). However, the difference in reporting attendance barriers among the three-different attendance frequency groups did not reach statistical significance ($p > 0.05$). Internet and accessing Cure4Kids problems were reported similarly in all three attendance groups.

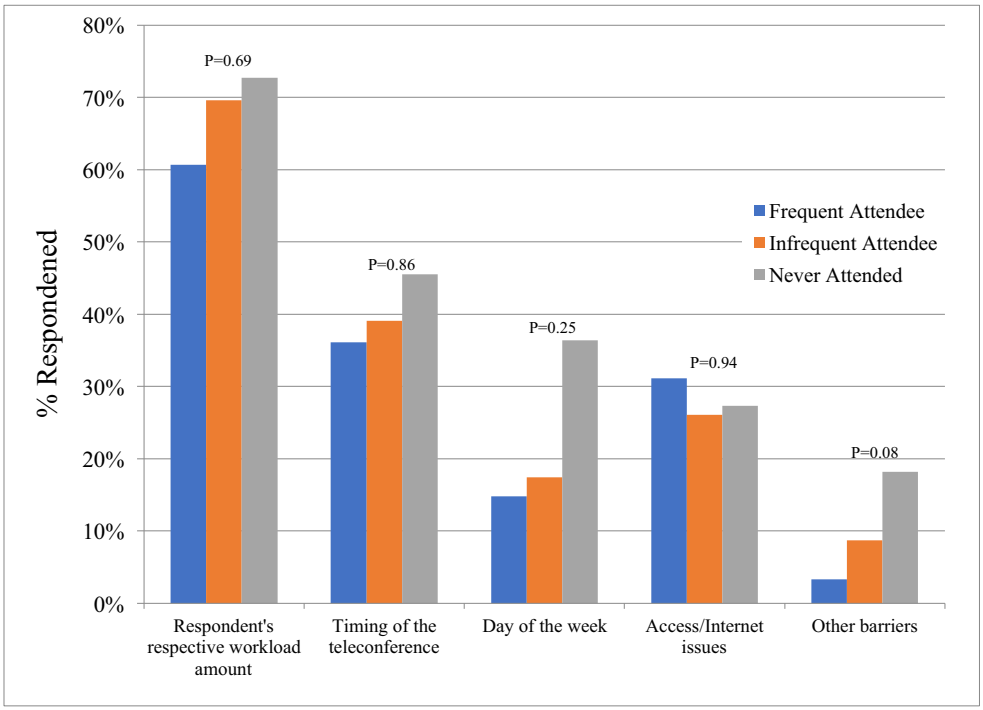

Fig. 3 Barriers and limitations to participate in the Latin American Brain Tumor Board teleconference

Sixty percent of frequent-attendance respondents reported workload as a limitation to participate in the teleconference compared with 70% of infrequent-attendance and 73% of never-attendance respondents ($p = 0.69$). Among the frequent-attendance group, workload was reported more frequently compared with all other barriers ($p < 0.05$) (Fig. 4). Among the infrequent-attendance group, workload was more frequently reported than all other barriers ($p < 0.05$) except for the timing of the teleconference ($p = 0.30$). Among the never-attendance group, there was no statistical difference in reporting attendance barriers.

Six respondents reported other limitations; two cited the incompatibility of the given recommendations to their local conditions. One respondent, who reported weekly attendance, stated that the teleconference minimizes the role of neuropathologists and pathologists from Latin America. Also, one respondent from Brazil cited language as a barrier. Finally, two respondents, who never participated in the teleconference, reported lack of information such as not knowing the time and day of the conference.

The participants' preparation time, frequency, and duration of the teleconference

Seventy-seven attendees (92%) of the teleconference (totally) agreed that the weekly frequency of the LATB was sufficient to discuss the requested cases. Furthermore, 70 attendees (83%) (totally) agreed that the duration of the teleconference (1 hour) was sufficient to cover the requested cases. Sixty-four attendees (67%) (totally) agreed with both previously mentioned statements. Finally, 66 attendees

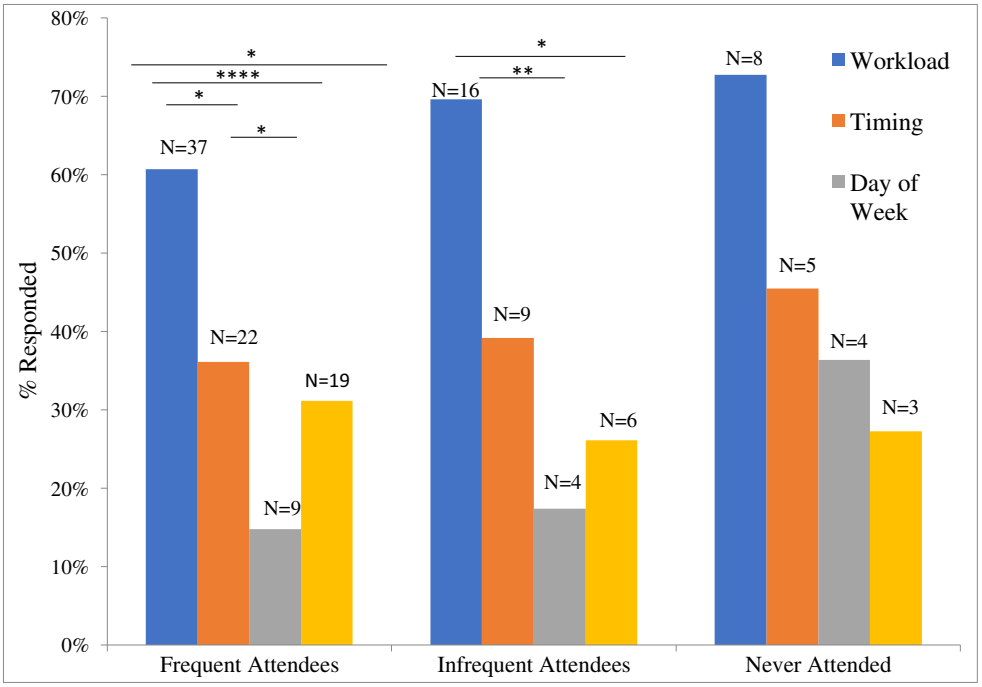

Fig. 4 Comparison between barriers to participate in the Latin American Brain Tumor Board teleconference between frequent-, infrequent-, and never-attendance groups

Barriers	Frequent attendance group	Infrequent attendance group	Never attendance group
	Holm adjusted value	Holm adjusted value	Holm adjusted value
Workload *vs* Timing	0.045	0.30	0.99
Workload *vs* Day of the week	< 0.0001	0.0064	0.99
Workload *vs* Access	0.01	0.0395	0.52
Timing *vs* Day of the week	0.045	0.57	0.99
Timing *vs* Access	0.70	0.99	0.99
Day of the week *vs* Access	0.11	0.99	0.99

* * = <0.05 ** = <.01 *** = <.001 **** = < .0001

(79%) reported that there was (almost) always enough time to prepare the unified template for submitting the requested cases before presenting them in the teleconference (Online Resource 2).

Education and recommendations provided during the teleconference

Eighty attendees (95%) (totally) agreed that using Spanish as the primary language to conduct the LATB teleconference made the discussion easier to understand and helped to provide clear recommendations. Two attendees from Brazil (2%) disagreed with the previous statement. Eighty-three attendees (99%) reported that the provided recommendations were (almost) always clear to follow. Seventy-one attendees (85%) found that the provided recommendations (almost) always fit their local circumstances. Thirteen attendees (15%) who stated that the recommendations fit occasionally or rarely their local conditions were from Argentina ($n = 1$), Colombia ($n = 1$), Ecuador ($n = 3$), El Salvador ($n = 1$), Honduras ($n = 3$), Mexico ($n = 1$), Panama ($n = 1$), and Venezuela ($n = 1$). Six of these attendees (46%) participated only once or twice in the teleconference, while seven (54%) reported frequent-attendance. Eighty-three attendees (99%) (totally) agreed that the teleconference provided an opportunity for continued medical education and helped in updating their medical knowledge in the field of pediatric neuro-oncology (Online Resource 2).

Eighty-one attendees (96%) (almost) always found that the recommendations helped to improve the outcomes and/or the quality of life of the discussed patients. While, none reported that the recommendations rarely, or (almost) never helped to improve the outcomes and/or the quality of life their patients (Fig. 5).

The post-teleconference summary reports

Seventy-nine respondents (83%) reported that they (almost) always checked the post-teleconference minutes/summary reports to keep themselves up to date even if they did not participate in the session. Seven (64%) out of the 11 never-attendance group stated that they (almost) always read the post-teleconference summary reports.

Eighty-eight respondents (93%) (totally) agreed with the statement that the post-teleconference minutes were sent within an appropriate time. Eighty-seven of them (92%) (totally) agreed that the post-teleconference summary reports were clear and easy to understand (Online Resource 3).

The inclusion of more subspecialties in the teleconference

Seventy-two attendees (86%) (totally) agreed on the need to include more subspecialties to the teleconference. Neuroradiology (70%), neuropathology (67%), and neurosurgery (65%) were the most requested subspecialties (Online Resource 4).

Sending pathology tissue for second-look review by the LATB pathologists

Thirty-three attendees (39%) (totally) agreed that sending pathology slides for a second-look in the USA was easy. Twenty-five attendees (30%) were neutral and 26 (31%) (totally) disagreed with the previously mentioned statement (Online Resource 2).

Forty-eight attendees (57%) reported that they (almost) always reviewed the results of the second opinion pathology

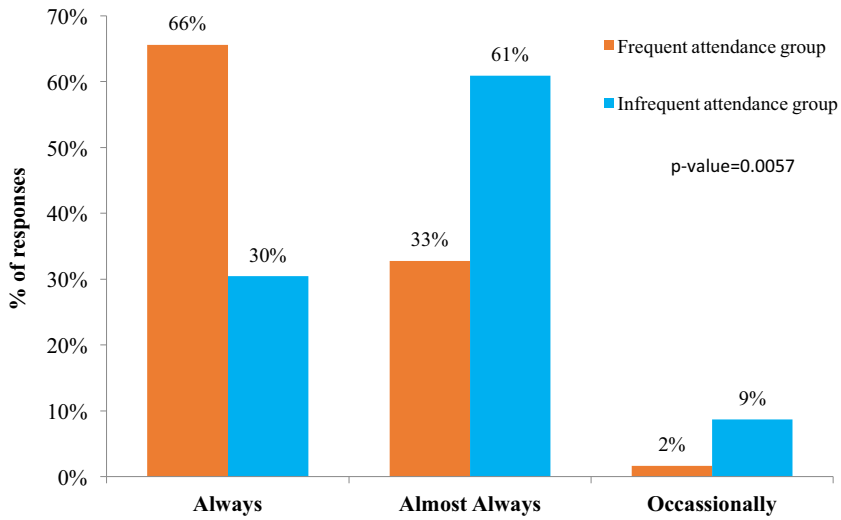

Fig. 5 Responses of frequent-attendance and infrequent-attendance group to the role of LATB in improving the outcome/quality of life of patients discussed in the teleconference

review with their institute pathologists. However, 26 attendees (31%) rarely or (almost) never reviewed the results of the second-look review with their pathologists (Online Resource 2).

Discussion

Telemedicine is a method used to exchange medical care expertise in various fields of medicine and has been increasingly utilized to connect highly specialized cancer centers in HIC with their counterparts in LMIC [8, 13–20]. We have been utilizing this methodology for our global pediatric neuro-oncology program to connect pediatric neuro-oncologists from dedicated centers in HIC with pediatric subspecialists from LMIC. Since the program has been running for the last 4 years, we felt it is valuable to assess the strengths and weaknesses of the program from the participants' perspective. The results of our questionnaire reflect an overall satisfaction in the utilization of this resource.

Professional health workers in LMIC have a significant workload that may affect their ability to participate in further work-related activities such as LATB [2]. In our study, subspecialists' workload was reported most often as a barrier to attending the LATB teleconference compared with all other barriers among all respondents regardless of their attendance frequency. There was no significant difference in reporting workload as a barrier among respondents on the basis of attendance frequency. It is notable that the subspecialists' workload was more frequently reported as a barrier in both the frequent- and infrequent-attendance groups compared with other attendance barriers ($p < 0.05$), with the exception for the timing of the teleconference in the infrequent-attendance group.

Due to the cross-sectional nature of the study, we cannot explore the association between timing of the teleconference and physician's workload and whether the general workload amount or time-specific workload (having work duties at the same time of the teleconference) hinders their participation. Moreover, the survey did not define workload or measured it by measurable objective parameters. Measurable elements may include the size of the hematology/oncology unit, patients' number per year, number of physicians serving the hematology/oncology unit, number of available supportive ancillary services, number of clinic days, and number of protected academic days per month. Analyzing workload parameters may provide a better understanding of the association between workload and frequency to attend the teleconference among the various attendance groups.

A significant portion of the respondents reported Internet and accessing Cure4Kids problems to limit their ability to attend the teleconference (between 25 and 30%) independent of attendance frequency. This may reflect that technical limitation was a not a major factor in limiting the participation in the meetings. However, improvements in data transmission that reduce technical barriers are still needed to facilitate the participants' utilization of the teleconference.

The LATB covers a large population in a broad geographical area with multiple centers in each of the 20 Latin American countries participating in the teleconference. More than 80% of the respondents found that weekly 1-hour sessions were sufficient to discuss the relevant cases from all participating centers.

The survey showed that the majority of the respondents considered the LATB teleconference both a continuing medical education opportunity and provided clear, easy to follow recommendations that were applicable to their local conditions. Almost all attendees (96%) found that the management recommendations provided in LATB (almost) always helped to improve the outcomes and/or the quality of life of the discussed patients. It is noticeable that the frequent-attendance group more often responded "always" compared with "almost always." However, there is not a meaningful difference between "always" and "almost always." The takeaway that neither group responded (rarely) never, which may reflect the benefit of the program to both groups—with the frequent-attendance group—reporting a slightly more positive outcome (Fig. 5). However, we should stress that our survey is not a reliable tool to measure the change of outcomes as it did not provide objective measurements to compare between the patients' outcomes prior and after the implementation of LATB, as this objective is outside the scope of this survey.

Conducting the teleconference in Spanish, the primary language of the majority of participants helped in making the recommendations clearer and easier to follow. Moreover, utilizing post-teleconference minutes provided the respondents with an educational tool to keep them updated in the field of pediatric neuro-oncology especially when they were not able to attend the sessions.

The survey results emphasized the need to include various related specialties in the teleconference to address the complexity of pediatric neuro-oncology. Neuroradiology, neuropathology, and neurosurgery were the most requested subspecialties. Previous experiences showed that telemedicine is feasible and effective in the fields of radiology and pathology [21–25]. Additionally, virtual interactive technologies for real-time long-distance surgical collaboration may improve telemedicine and global neurosurgical education opportunities [26, 27]. The role of telemedicine in palliative care is not well established [28, 29]. However, teleconferenced educational sessions may provide guidance for centers with no specialized palliative care team.

It is notable that a third of the respondents did not find sending the pathology samples for review by the LATB pathology experts easy. It is our understanding that this is attributed mainly to the financial costs and administrative barriers

to shipping the specimens to the referral centers. Moreover, on some occasions, the surgery may be done in different centers which limit the ability to obtain the tissue samples. In our survey, we did not specifically explore the reasons or the limitations of sending tissue specimen for pathological review in the referral centers. Moreover, 43% of the respondents did not (almost) always review the results of the LATB experts' pathology reviews with their local pathologists. This may reflect the busy schedule of the participating physicians that may limit their ability to communicate with their local pathologist, or/and the need to implement better multidisciplinary communication tools in the participating hospitals. However, we have since specifically encouraged review of confirmatory pathology with their local pathologist and team to boost education and team building.

The study has multiple limitations that may influence the interpretation of the results and its conclusions. The cross-sectional design captured only a single point of the LATB participants' experience. This precludes our ability to examine any causality or association relationship between the reported feedback and the different processes of the LATB. The 60% response rate and the small sample size of the respondents who never attended the LATB teleconference ($n = 11$) may reduce its ability to unmask other limitations to attending the teleconference, especially in the never-attendance group. Additionally, utilizing surveys may lead to sampling bias as the frequent users tend to be more responsive which may underrepresent the infrequent- or never-attendance groups.

Conclusions

Our survey reflects the feasibility of utilizing telemedicine to provide a practical, while not time- and effort-consuming, tool to distribute medical knowledge in the field of pediatric neuro-oncology over large geographical areas. Participants' workload is the main barrier to participate in the teleconference. The participation of colleagues from all neuro-oncology disciplines will enrich the multidisciplinary approach of the neuro-oncology teleconference and may facilitate multidisciplinary cooperation in and between institutions for the benefit of children affected by brain tumors.

Acknowledgments We would like to thank Dr. Scott L. Coven, DO, MPH for his contribution to this study and his role in reviewing the manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Rodriguez-Galindo C, Friedrich P, Alcasabas P, Antillon F, Banavali S, Castillo L, Israels T, Jeha S, Harif M, Sullivan MJ, Quah TC, Patte C, Pui CH, Barr R, Gross T (2015) Toward the cure of all children with cancer through collaborative efforts: pediatric oncology as a global challenge. J Clin Oncol 33(27):3065–3073
2. Aristizabal P, Fuller S, Rivera-Gomez R, Ornelas M, Nuno L, Rodriguez-Galindo C, Ribeiro R, Roberts W (2017) Addressing regional disparities in pediatric oncology: results of a collaborative initiative across the Mexican–North American border. Pediatr Blood Cancer 64(6):e26387
3. Farmer P, Frenk J, Knaul FM, Shulman LN, Alleyne G, Armstrong L, Atun R, Blayney D, Chen L, Feachem R, Gospodarowicz M, Gralow J, Gupta S, Langer A, Lob-Levyt J, Neal C, Mbewu A, Mired D, Piot P, Reddy KS, Sachs JD, Sarhan M, Seffrin JR (2010) Expansion of cancer care and control in countries of low and middle income: a call to action. Lancet 376(9747):1186–1193
4. Stiller CA, Nectoux J (1994) International incidence of childhood brain and spinal tumours. Int J Epidemiol 23(3):458–464
5. Ostrom QT, Gittleman H, Liao P, Vecchione-Koval T, Wolinsky Y, Kruchko C, Barnholtz-Sloan JS (2017) CBTRUS statistical report: primary brain and other central nervous system tumors diagnosed in the United States in 2010-2014. Neuro-Oncology 19(suppl_5):v1–v88
6. United Nations, Department of Economic and Social Affairs, Population Division: World Population Prospects (2017) The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.NewYork:UnitedNations.https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf. Accessed 15 July 2018
7. Baskin JL, Lezcano E, Kim BS, Figueredo D, Lassaletta A, Perez-Martinez A, Madero L, Caniza MA, Howard SC, Samudio A, Finlay JL (2013) Management of children with brain tumors in Paraguay. Neuro-Oncology 15(2):235–241
8. Chan MH, Boop F, Qaddoumi I (2015) Challenges and opportunities to advance pediatric neuro-oncology care in the developing world. Childs Nerv Syst 31(8):1227–1237
9. Wagner HP, Antic V (1997) The problem of pediatric malignancies in the developing world. Ann N Y Acad Sci 824(1):193–204
10. Biesma RG, Brugha R, Harmer A, Walsh A, Spicer N, Walt G (2009) The effects of global health initiatives on country health systems: a review of the evidence from HIV/AIDS control. Health Policy Plan 24(4):239–252
11. Hopkins J, Burns E, Eden T (2013) International twinning partnerships: an effective method of improving diagnosis, treatment and care for children with cancer in low-middle income countries. J Cancer Policy 1(1):e8–e19
12. U.S. Department of Health and Human Services Centers for Disease Control and Prevention. Office of the Director, Office of Strategy and Innovation (2011) Introduction to program evaluation for public health programs: a self-study guide. Atlanta, GA: Centers for Disease Control and Prevention, https://www.cdc.gov/eval/guide/CDCEvalManual.pdf. Accessed 15 July 2018
13. Ribeiro RC, Pui C-H (2005) Saving the children — improving childhood cancer treatment in developing countries. N Engl J Med 352(21):2158–2160
14. Masera G, Baez F, Biondi A, Cavalli F, Conter V, Flores A, Fontana G, Fossati Bellani F, Lanfranco P, Malta A, Mendez G, Ocampo E, Pacheco C, Riva L, Sala A, Silva F, Sessa C, Tognoni G (1998) North-south twinning in paediatric haemato-oncology: the La Mascota programme, Nicaragua. Lancet 352(9144):1923–1926
15. Veerman AJP, Sutaryo S (2005) Twinning: a rewarding scenario for development of oncology services in transitional countries. Pediatr Blood Cancer 45(2):103–106

16. Amayiri N, Swaidan M, Abuirmeileh N, Al-Hussaini M, Tihan T, Drake J, Musharbash A, Qaddoumi I, Tabori U, Halalsheh H Bartels U, Bouffet E (2018) Video-teleconferencing in pediatric neuro-oncology: ten years of experience. J Glob Oncol 4:1–7
17. Hazin R, Qaddoumi I (2010) Teleoncology: current and future applications for improving cancer care globally. Lancet Oncol 11(2): 204–210
18. Francisco P, Faisal S, Gaston R, Raul R, Ibrahim Q (2017) The impact of prospective telemedicine implementation in the Management of Childhood Acute Lymphoblastic Leukemia in Recife, Brazil. Telemed J E Health 23(10):863–867
19. Qaddoumi I, Nawaiseh I, Mehyar M, Razzouk B, Haik BG, Kharma S, Jaradat I, Rodriguez-Galindo C, Wilson MW (2008) Team management, twinning, and telemedicine in retinoblastoma: a 3-tier approach implemented in the first eye salvage program in Jordan. Pediatr Blood Cancer 51(2):241–244
20. Qaddoumi I, Mansour A, Musharbash A, Drake J, Swaidan M, Tihan T, Bouffet E (2007) Impact of telemedicine on pediatric neuro-oncology in a developing country: the Jordanian-Canadian experience. Pediatr Blood Cancer 48(1):39–43
21. Maher L, Craig A, Menezes G (2007) A national survey of telemedicine in the Republic of Ireland. J Telemed Telecare 13(7):348–351
22. Wiley CA, Murdoch G, Parwani A, Cudahy T, Wilson D, Payner T, Springer K, Lewis T (2011) Interinstitutional and interstate teleneuropathology. J Pathol Inform 2(1):21–21
23. Ng WH, Wang E, Ng I, Bernstein M (2009) Teleradiology and emergency neurosurgery-presence in a small Asian City state and need in a large Canadian Province. J Brain Dis 1:7–11
24. Rosenberg C, Kroos K, Rosenberg B, Hosten N, Flessa S (2013) Teleradiology from the provider's perspective—cost analysis for a mid-size university hospital. Eur Radiol 23(8):2197–2205
25. Santiago TC, Jenkins JJ, Pedrosa F, Billups C, Quintana Y, Ribeiro RC, Qaddoumi I (2012) Improving the histopathologic diagnosis of pediatric malignancies in a low-resource setting by combining focused training and telepathology strategies. Pediatr Blood Cancer 59(2):221–225
26. Shenai MB, Tubbs RS, Guthrie BL, Cohen-Gadol AA (2014) Virtual interactive presence for real-time, long-distance surgical collaboration during complex microsurgical procedures. J Neurosurg 121(2):277–284
27. Davis MC, Can DD, Pindrik J, Rocque BG, Johnston JM (2016) Virtual interactive presence in global surgical education: international collaboration through augmented reality. World Neurosurg 86:103–111
28. Hoek PD, Schers HJ, Bronkhorst EM, Vissers KCP, Hasselaar JGJ (2017) The effect of weekly specialist palliative care teleconsultations in patients with advanced cancer –a randomized clinical trial. BMC Med 15(1):119
29. Head BA, Schapmire TJ, Zheng Y (2017) Telehealth in palliative care: a systematic review of patient-reported outcomes. J Hosp Palliat Nurs 19(2):130–139