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LONGITUDINAL EVALUATION USE OF A MULTI-MODAL TOOLKIT TO SUPPORT PREHOSPITAL PEDIATRIC READINESS

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ABSTRACT

Objective: The National Prehospital Pediatric Readiness Project (PPRP) supports emergency medical services (EMS) efforts to deliver high-quality care to acutely ill and injured children through dissemination of best practices. Toolkits are essential for implementing new initiatives for system improvement. Central to this effort is a toolkit developed by the PPRP to guide EMS agencies in pediatric readiness improvements. The perceived utility of the PPRP Toolkit by end-users is unknown. This study aimed to evaluate end-user analytics and satisfaction with this Toolkit to inform future enhancements.

Methods: We present a descriptive case study examining the development, dissemination, and evaluation of the Toolkit. Website analytics from April 2021 to June 2023 were reviewed to assess engagement, including total page views and time spent per page. We conducted a snowball sampling frame to recruit pediatric emergency care coordinators and EMS educators to complete a structured survey evaluating the Toolkit. Respondents rated the usefulness and ease of resource navigation using a 5-point Likert scale.

Results: The Toolkit generated 193,500 page views, with users spending an average of 11 minutes per page. The most frequently accessed domains were Education and Competencies, Equipment and Supplies, and Policies, Procedures, and Protocols. The median score for both ease of access and resource usefulness was 4/5. Quality Improvement/Process Improvement received the lowest median score (ease: 2, helpfulness: 3) and Interactions with Systems of Care were the highest (ease: 5, helpfulness: 5).

Conclusion: The Toolkit is a well-utilized and valued resource for enhancing pediatric readiness in EMS systems. While overall feedback was positive, lower ratings for the QI/PI category suggest opportunities for targeted improvement. Continued refinement, guided by end-user feedback and usage patterns, will be critical to ensure the Toolkit remains effective, relevant, and responsive to the evolving needs of prehospital pediatric readiness.

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INTRODUCTION

Ensuring the health and safety of our youngest and most vulnerable patients is an important concern in emergency medical services (EMS). Acutely ill and injured children present unique challenges and require specialized care distinct from adults (Institute of Medicine, 2007). Of the over 53 million annual EMS 911 activations in 2022, only 5.6% were for children (National EMS Information System [NEMSIS], 2023). Despite this small percentage, children transported to the emergency department (ED) by EMS have higher-acuity illnesses and injuries than those arriving via private vehicle (Diggs et al., 2016). With children representing only 5–10% of EMS 911 activations and 39% of EMS agencies seeing less than one child per month, maintaining pediatric-specific cognitive and procedural skills among EMS clinicians is challenging (Owusu-Ansah et al., 2020; EMS for Children (EMSC) Data Center, 2022).

In 2020, the American Academy of Pediatrics, American College of Emergency Physicians, Emergency Nurses Association, National Association of EMS Physicians (NAEMSP), and National Association of Emergency Medical Technicians authored a joint policy statement, "Pediatric Readiness in Emergency Medical Services Systems" outlining pediatric readiness best practices for prehospital care (Moore et al., 2020), with details supporting the recommendations published separately in a technical report (Owusu-Ansah et al., 2020) to address the challenges faced by EMS. To advance these recommendations, the National Prehospital Pediatric Readiness Project (PPRP) was formed in 2019 and is led by a Steering Committee composed of 30 partners with the primary goal to support EMS and fire-rescue agencies with resources that include a pediatric readiness Checklist and a multimedia Toolkit.

Before the PPRP, no comprehensive prehospital pediatric readiness resource existed. Similar to previous efforts to recruit and support pediatric emergency care coordinators (PECCs) and promote statewide prehospital guidelines, the Prehospital Pediatric Readiness Toolkit was developed as a multi-modal resource for EMS clinicians, educators, and agency leadership (Tsao et al., 2023; Adelgais et al., 2019; Williams et al., 2009). Following best practices in program implementation, we sought to obtain user feedback and analytics to inform future iterations of the toolkit (Buckingham et al., 2023; Maltby et al., 2020). The goal of this study is to describe the development of the Toolkit and report on user analytics and end-user feedback with implications for refinement.

METHODS

Design

We describe the development and evaluation of a national Toolkit for prehospital pediatric readiness intended for EMS clinicians, educators, and PECCs. Project team members curated and disseminated resources and conducted a follow-up survey of targeted stakeholders to evaluate the Toolkit's organization, content, and usability.

Toolkit Development

The PPRP Steering Committee established the Toolkit Workgroup with representatives from 18 organizations [Appendix A] tasked with curating open access materials aligned with a readiness Checklist developed from recommendations in the joint policy state-

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Domain	Purpose of tools
Education and Competencies	Enhance EMS pediatric education along with tools to objectively evaluate prehospital pediatric competency
Equipment and Supplies	Provide national recommendations on equipment and supplies to support the delivery of quality prehospital pediatric care
Patient and Medication Safety	Support reduction of common medication errors and provide information for the safe transport of children in ambulances
Patient and Family-Centered Care	Assist EMS agencies with incorporating patient and family-centered principles into policies and procedures
Policies, Procedures, and Protocols	Provide guidance on creating and incorporating pediatric considerations into policies, procedures, and protocols
Quality Improvement/Process Improvement (QI/PI)	Support prehospital pediatric quality improvement and guide the implementation of effective process improvement strategies
Interactions with Systems of Care	Facilitate collaboration among partner organizations and systems of care to enhance coordination and continuity for pediatric patients across the care continuum

Table 1. Toolkit domains and their respective resource purposes for pediatric prehospital care.

ment and technical report (Owusu-Ansah et al., 2020; Moore et al., 2020). The PPRP Toolkit Workgroup modeled best practices in toolkit creation (Thoele et al., 2020), meeting quarterly to share and review resources corresponding to items on the Prehospital Pediatric Readiness Checklist, organized into readiness domains (Table 1). The Toolkit was launched in April 2021.

The PPRP Toolkit includes videos, documents, interactive modules, position statements, white papers, sample policies, and training curricula that are reviewed and updated quarterly. The toolkit, accessible on the EMSC Innovation and Improvement Center (EIIC) website (EIIC, n.d.), features a search bar, filters, and an introductory video. Top resources are 'pinned' for easy access. A "Contact Us" option for submitting materials is available and submissions undergo review for alignment with Checklist recommendations.

User Analytics

Website usage data were obtained from Google Analytics for the period April 1, 2021, to June 30, 2023, prior to a platform upgrade in July 2023, to ensure consistency in analyses. A cross-sectional assessment of user engagement metrics was conducted using data from the original Google Analytics platform. Metrics included page views, time spent per domain, and most frequently visited resources. Page views reflected total content views, while unique page views represented aggregated views by the same user within a single browsing session.

User Centered Feedback

We solicited targeted feedback in September 2023 from end-users representing diverse prehospital roles and settings (Table 2) via an online survey [Appendix B]. For recruitment, we employed a snowball sampling approach to recruit Pediatric Emergency Care Coordinators (PECCs) and EMS educators to complete a structured survey evaluating the Toolkit. This method involved initially contacting a small group of eight EMSC program managers who were then asked to refer additional participants. Ultimately, we obtained contact information for 31 additional PECCs and EMS educators, as well as 3 members of the PPRP Steering Committee. This resulted in a total of 42 individuals who were contacted via email, of whom 37 responded. Outcomes of interest included previously reported user-centered metrics essential for successful Toolkit implementation: the toolkit's

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organization, usability, and overall value (Barac et al., 2014; Yamada et al., 2015; Hempel et al., 2019). Participants reviewed toolkit domains and rated the helpfulness of the resource and ease of navigation on a 1 (worst) to 5 (best) Likert scale. Additional qualitative feedback was obtained, especially from those rating domains poorly (score 1-2). Given that the intent of the survey was to glean key information about the toolkit, pilot testing and follow up cognitive interviews to evaluate the survey itself were not performed.

Ethical Consideration

This project does not involve human subjects or identifiable patient health information and therefore did not require Institutional Review Board (IRB) oversight.

Professional Role Type	N (%)
EMS Clinician[1]	18 (49%)
EMS Educator	13 (35%)
PECC/Pediatric Champion	12 (32%)
EMS Program Manager/Project Director	6 (16%)
PPRP Steering Committee Member[2]	4 (11%)
EMS Medical Director[3]	0 (0%)
Other • EMS for Children Advisory Committee Member (2) • Disaster Preparedness Expert (3) • Deputy Chief of EMS • Operations Officer • Continuous Quality Improvement Supervisor	8 (22%)
1 - Includes emergency medical technicians and paramedics 2 - Includes only those members not participating in the Toolkit Work Group 3 - Physicians who commonly have additional training in EMS and/or emergency medicine	

Table 2. Professional roles and number (percentage) of respondents to the feedback survey.

RESULTS:

Since August 2020, 172 resources were curated into seven Checklist domains (Table 3).

User Analytics

The Toolkit received 193,500 page views and 23,554 unique page views. Quarterly visits increased from 13,609 to 28,335 by mid-2023, peaking at 32,861 in early 2023 (Figure 1). The most visited domain was Education and Competencies with 22,130 page views, followed by Equipment and Supplies with 7,416 (Table 3). Users spent an average of 10.76 minutes per domain, ranging from 3.6 minutes on Education and Competencies to 12.48 minutes on Quality Improvement (QI)/Process Improvement (PI).

Subdomain analysis inferred by the number of unique page views showed strong engagement in all three subdomains within Education and Competencies, . ,in the "Pediatric Protocols and Guidelines" and "Dispatch and Prearrival Instructions" subdomains of Policies, Procedures and Protocols, "Safe Medication Dosing" within the Patient and Medication Safety domain, and "Guidelines and General Resources" under the Patient- and Family-Centered Care domain (Table 3). The PECC Roles subdomain within Interactions with Systems of Care also saw notable interest inferred from the number of unique page views. Top resources included SimBox EMS, Autism First Responder Training Video, and Equipment Checklist Examples and Grant Opportunities (Table 4).

Feedback Survey

Out of 42 reviewers surveyed, 37 responded (88%), with between four to seven responses per domain (Figure 2). Respondents included various geographic and agency types of EMS clinicians, educators, PECCs, EMS for EMSC State Partnership program managers/

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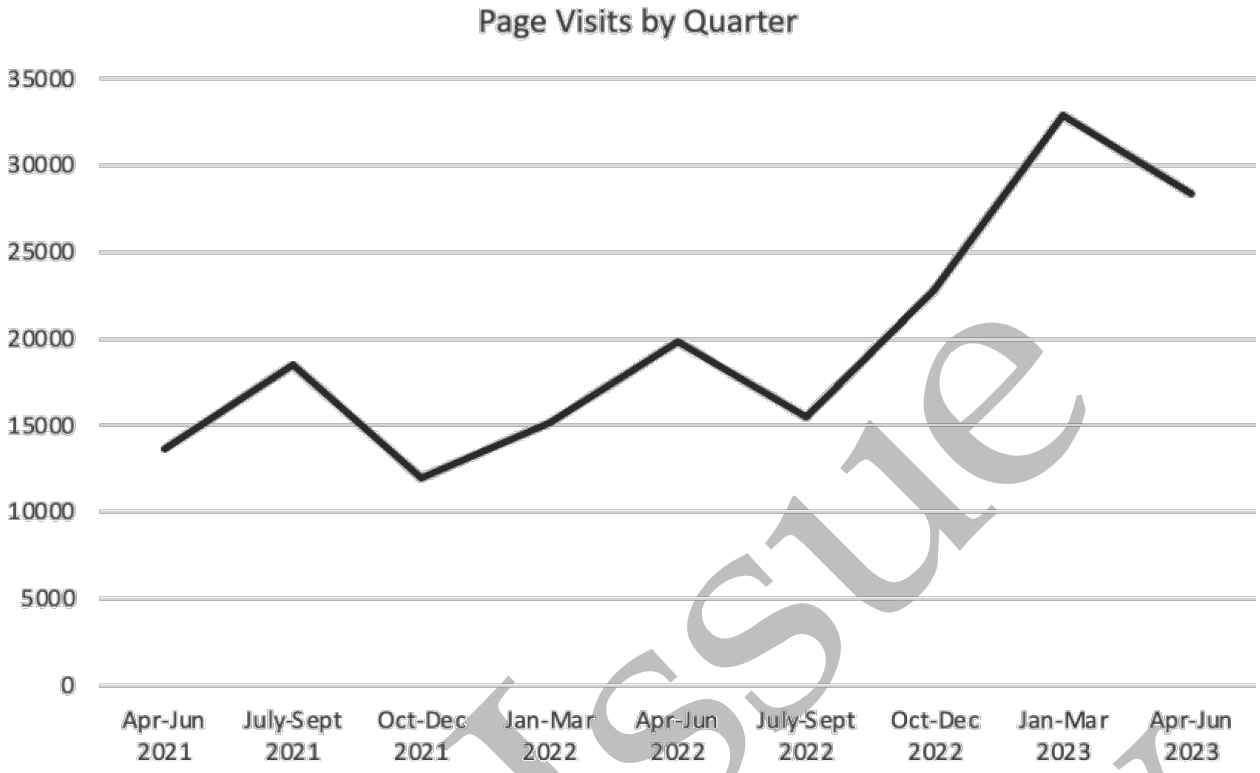

Figure 1. Page visits by quarter.

PPRP Toolkit Domain	Page Views (Unique)	Average Time (Min)
Total Resources (n=172)	**193500 (23554)**	**10.76**
Education and Competencies (n=44)	22130 (2411)	3.60
• Psychomotor (Procedural) Skills	• 6793 (838)	• 19.48
• Cognitive Skills	• 4434 (526)	• 11.59
• Behavioral (Communication) Skills	• 2606 (332)	• 13.81
Equipment and Supplies (n=3)	7416 (878)	7.67
Policies, Procedures, and Protocols (n=50)	5742 (529)	7.11
• Pediatric Protocols and Guidelines	• 3093 (350)	• 18.24
• Dispatch and Pre-arrival Instructions	• 1232 (147)	• 14.45
• Policy/Position Statements	• 910 (108)	• 22.61
• Medical Direction/Oversight Resources	• 515 (65)	• 17.81
Patient and Medication Safety (n=15)	4443 (462)	5.32
• Safe Medication Dosing	• 2112 (256)	• 22.08
• Safe Transport of Children	• 1016 (132)	• 10.08
Quality and Process Improvement (n=8)	4011 (504)	12.48
Patient- and Family-Centered Care (n=15)	3908 (373)	6.5
• Guidelines and General Resources	• 1342 (155)	• 19.16
• Communication Tools	• 998 (118)	• 6.53
• Disaster Preparedness	• 490 (61)	• 15.33
• Assessments	• 477 (56)	• 6.17
Interactions with Systems of Care (n=37)	2758 (292)	12.4
• PECC Roles/Job Descriptions	• 1083 (136)	• 23.93
• Mental/Behavioral Health	• 822 (98)	• 18.79
• Disaster Preparedness	• 621 (89)	• 24.00
• Handoffs/Transfer of Care	• 378 (50)	• 15.07
• Human Trafficking	• 279 (37)	• 13.24

Table 3. User engagement metrics by toolkit domain and subdomains: total page views, unique page views, and average time spent per page.

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Top Resources	Page Views (Unique)	Average Time (Min)
Education and Competencies		
SimBox EMS	4166 (538)	15.67
Autism First Responder Training Video	2110 (341)	11.76
School Shooting Simulation (PRIDE)	1212 (160)	10.84
Equipment and Supplies		
Equipment Checklist Examples	2444 (346)	14.92
Grant Opportunities	2209 (272)	20.98
Patient- and Family-Centered Care		
Communication Cards	705 (79)	13.55
Family Assessment of Medical Interventions & Liaisons with the Young (FAMILY) EMS Instrument	552 (70)	6.98
Quality and Process Improvement		
NEMSQA Pediatric Measures	820 (115)	21.22
Institute for Healthcare Resources	563 (75)	9.71

Table 4. User engagement metrics for top resources by domain: total page views, unique page views, and average time spent per page.

directors, PPRP Steering Committee members, among others (Table 2). Median ratings for ease of locating resources and usefulness were above 3.5 for six of seven domains (Figure 3). Interaction with Systems of Care scored highest (5/5) followed by Education and Competencies (helpfulness 4.75, ease 4). Equipment and Supplies and Policies, Procedures, and Protocols scored a 4 in both categories. Patient- and Family-Centered Care scored 3.5 for helpfulness and 4 for ease of use. QI/PI scored lowest with 3 for helpfulness and 2 for ease of use.

DISCUSSION

Toolkits are effective knowledge translation tools that help disseminate information, increase awareness, and support new initiatives in healthcare (Barac et al., 2014). Since August 2020, the Prehospital Pediatric Readiness Project Toolkit is the most comprehensive open-access resource available to support prehospital pediatric readiness. With over 170 resources, there is no other publicly available resource with the breadth of information and tools currently available for the EMS community to support the care of children.

Since its implementation, the Toolkit's sustained and growing usage highlights its importance within the EMS community. The Education and Competencies domain has emerged as the most accessed, signaling an interest in pediatric education resources within EMS. While feedback indicates that the Toolkit is highly rated and easy to use, a deeper examination into subdomain utilization reveals that Psychomotor Skills and Safe Medication Dosing further indicate prioritized areas, and the popularity of practical tools like SimBox EMS and the Autism First Responder Training video underscores the need for hands-on, condition-specific resources. Of note, the EMSC program has been measuring skills assessment with pediatric equipment annually since 2017, with little improvement over the last few years (Hewes, Ely, et al., 2019; Hewes, Genovesi, et al., 2022), suggesting that further promotion of Toolkit resources may enhance readiness.

User feedback confirms that the Toolkit is highly valued and user-friendly, described as a "living document" incorporating continuous updates. However, the lower QI/PI and

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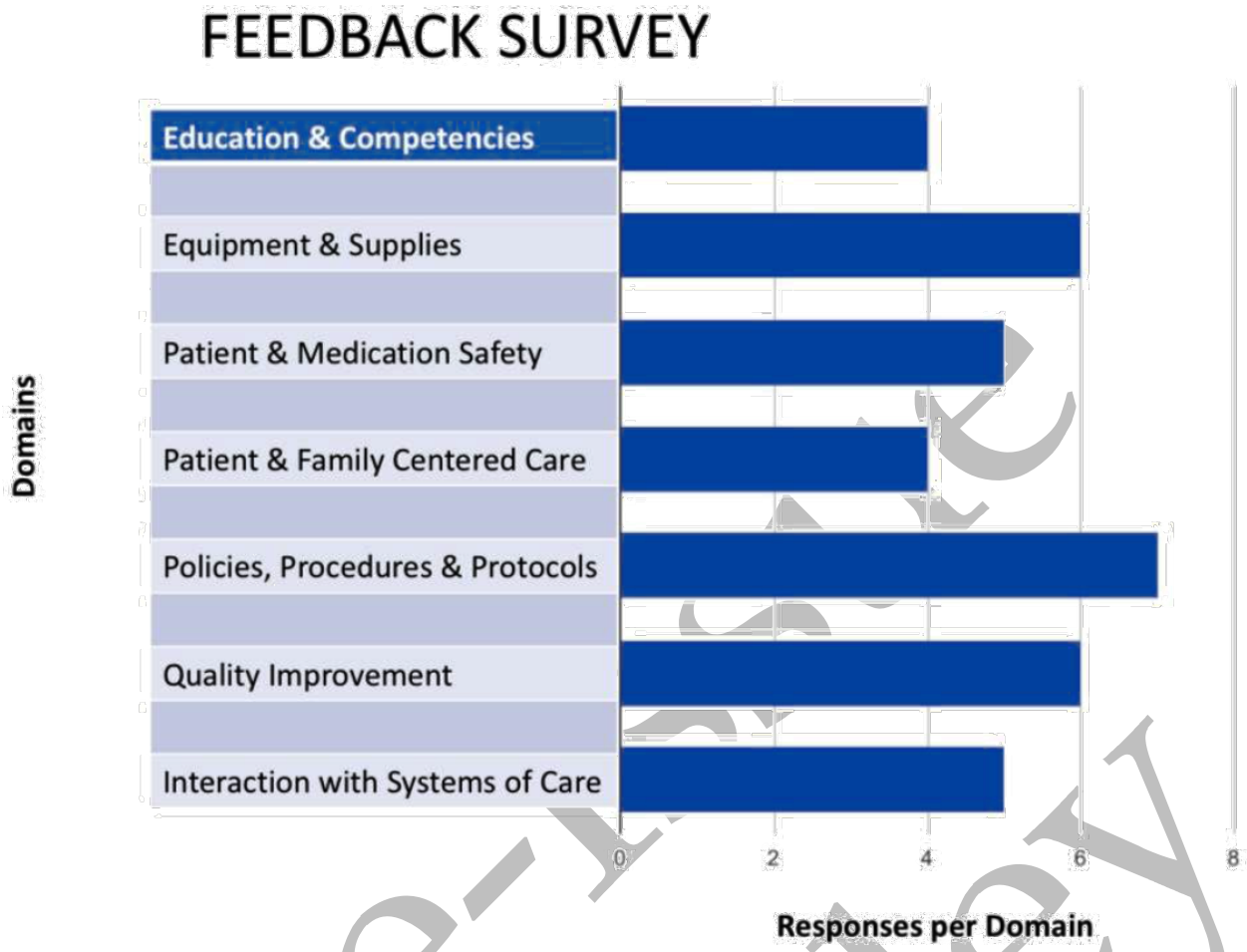

Figure 2. Feedback survey responses per domain.

Patient Medication Safety domains ratings indicate challenges with content complexity, quality, organization, and resource accessibility. This aligns with the inherent difficulties in QI and medication safety practices, suggesting a need for more targeted resources and training materials that address these specific concerns. Notably, NAEMSP has developed a quality committee that evaluates QI/PI initiatives. Furthermore, the National EMS Quality Alliance (NEMSQA) is leading multiple national QI projects such as the Lights and Siren Collaborative to improve the safety of EMS response and transport. While user analytics demonstrate that the NEMSQA resources are widely used, current NEMSQA quality measures lack pediatric focus, with only two out of 20 measures specific to children.

To address these gaps, ongoing collaborations with the Institute for Healthcare Improvement, NEMSQA, and the National EMS Information System (NEMSIS) Technical Assistance Center aim to produce more pediatric-specific, user-friendly QI resources. NEMSIS now hosts a set of prehospital pediatric readiness quality measures (NEMSIS, n.d.) developed through a consensus process by a technical expert panel with 7 core clinical process and outcome-based measures covering a range of common pediatric prehospital conditions. The dashboard includes filters by urbanicity, EMS organizational type, patient volume, and level of care. It is anticipated that future iterations of the dashboard may include a filter by a readiness score from the 2024 National PPRP Assessment (Ward, 2024).

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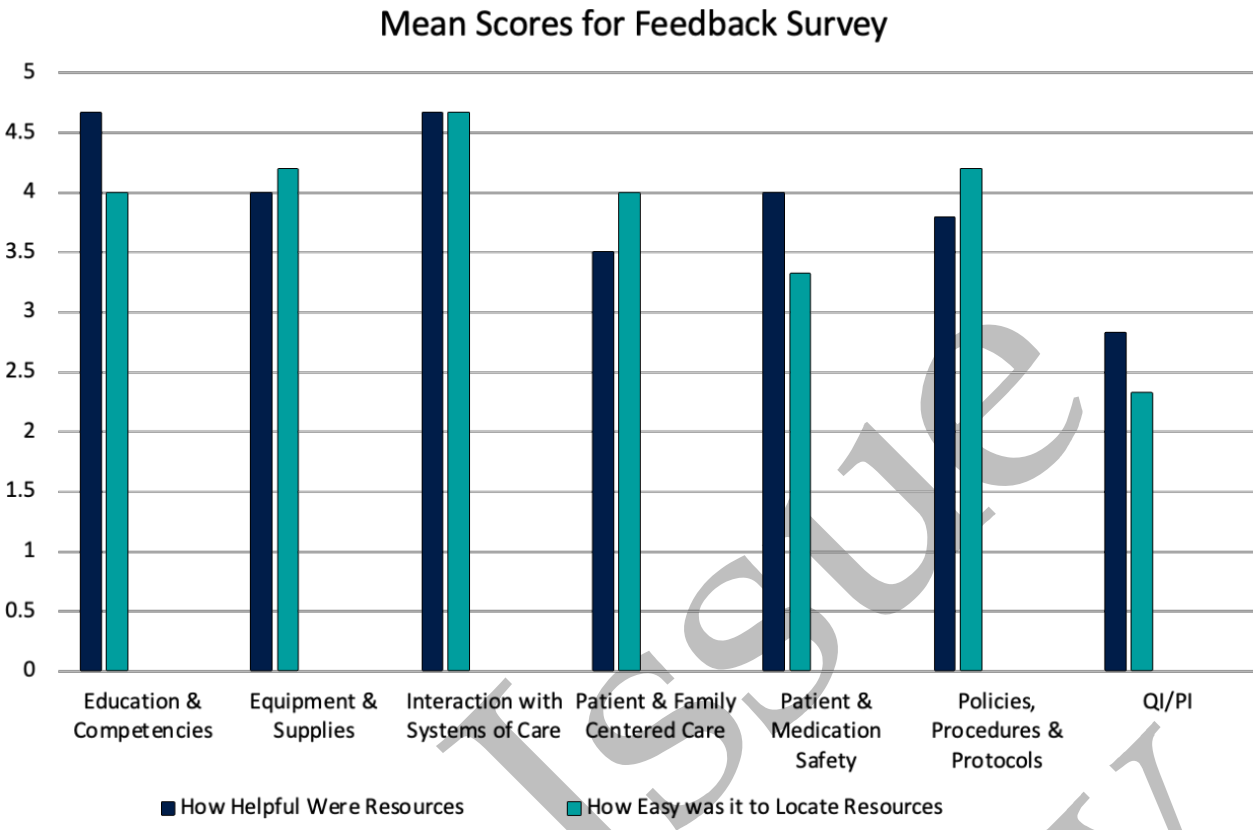

Figure 3. Median scores (IQR) of end-user feedback survey.

Other established toolkits, such as the National Pediatric Readiness Project (NPRP) Toolkit, focus on pediatric ED care and readiness and have been successfully integrated into quality improvement initiatives, including two national collaboratives (Pediatric Readiness Quality Collaborative 1.0 and 2.0 and one established QI registry (National Pediatric Readiness Quality Initiative [NPRQI], n.d.). Like the process for the NPRP Toolkit for EDs, the PPRP Toolkit will be integrated into quality initiatives and collaborative efforts. Data from the national PPRP Assessment (completed in July 2024) will identify gaps in prehospital readiness which will inform which resources are critically needed (EMS-pedsReady, n.d.). Using feedback from the end-users, future directions are to develop a tailored curriculum or user-guide to improve navigation and resource comprehension which can facilitate efficient use of the Toolkit and support EMS agencies' pediatric readiness goals to provide high quality care to children. Ultimately, EMS agencies will be able to use their pediatric readiness scores to identify areas for improvement and turn to the PPRP Toolkit for necessary and optimal resources.

LIMITATIONS

Our report has several limitations. Google Analytics data could not isolate unique visitors, so views from content creators may inflate totals. However, the steady increase in page views suggests growing unique user engagement. Additionally, analytic limitations prevented assessment of user return rates or repeated visits to specific resources. We acknowledge that our survey respondents may not be nationally representative of all EMS personnel, but our goal was to focus on engaged users from diverse roles and settings to capture relevant perspectives. Our feedback survey serves as a proxy to provide valuable information on the usability of the toolkit. Finally, Toolkit data collection ended in June

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2023 and we were unable to provide IQRs for the summary statistics displayed in Tables 3 and 4 due to changes in the Google Analytics reporting mechanism and upgrades to a different platform in July 2023, limiting longitudinal comparisons. Despite these constraints, the data provides useful insights into toolkit usage and usability during its rollout and early adoption phase.

Future Directions

Prospective study on the effectiveness of the toolkit is needed. A comparison of EMS agencies that use the Toolkit with those relying on standard resources will provide valuable information to support future refinements to the resources and exploration into outcome measures linking Toolkit usage to pediatric readiness scores and patient outcomes would provide valuable insight into its impact. Finally, based on survey feedback, the creation of additional QI/PI resources is a critical next step.

CONCLUSION

User analytics and feedback on the Toolkit demonstrate strong engagement and that it provides valuable, curated resources to enhance pediatric readiness in EMS. The domains Education and Competencies and Equipment and Supplies are the most accessed and highly rated domains. The QI/PI domain requires the addition of user-friendly content and pediatric-specific quality measures. The Toolkit's continued evolution, guided by end-user feedback and usage patterns, will ensure that it remains a relevant and effective tool in advancing the quality of prehospital pediatric readiness.

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