

ORIGINAL RESEARCH

Factors influencing rural and urban emergency clinicians' participation in an online knowledge exchange intervention

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ABSTRACT

Introduction: Rural emergency departments (EDs) generally have limited access to continuing education and are typically staffed by clinicians without pediatric emergency specialty training. Emergency care of children is complex and the majority of children receive emergency care in non-pediatric tertiary care centers. In recent decades, there has been a call to action to improve quality and safety in the emergency care of children. Of the one million ED visits by children in Ontario in 2005–2006, one in three visited more than once in a year and one in 15 returned to the ED within 72 hours of the index visit. This study explored factors influencing rural and urban ED clinicians' participation in a Web-based knowledge exchange intervention that focused on best practice knowledge about pediatric emergency care. The following questions guided the study: (i) What are the individual, context of practice or knowledge factors which impact a clinician's decision to participate in a Web-based knowledge exchange intervention?; (ii) What are clinicians' perceptions of organizational expectations regarding knowledge and information sources to be used in practice?; and (iii) What are the preferred knowledge sources of rural and urban emergency clinicians?

Methods: A Web-based knowledge exchange intervention, the Pediatric Emergency Care Web Based Knowledge Exchange Project, for rural and urban ED clinicians was developed. The website contained 12 pediatric emergency practice learning modules with linked asynchronous discussion forums. The topics for the modules were determined through a needs assessment and the module content was developed by known experts in the field. A follow-up survey was sent to a convenience sample of 187 clinicians



from nine rural and two urban Canadian EDs participating in the pediatric emergency Web-based knowledge exchange intervention study.

Results: The survey response rate was 56% (105/187). Participation in the knowledge exchange intervention was related to individual involvement in research activities ($\chi^2=5.23$, $p=0.019$), consultation with colleagues from other EDs ($\chi^2=6.37$, $p=0.01$) and perception of organizational expectations to use research evidence to guide practice ($\chi^2=5.52$, $p=0.015$). Most clinicians (95/105 or 92%) reported relying on colleagues from their own ED as a primary knowledge source. Urban clinicians were more likely than their rural counterparts to perceive that use of research evidence to guide practice was an expectation. Rural clinicians were more likely to rely on physicians from their own ED as a preferred knowledge source.

Conclusion: The decision made by emergency clinicians to participate in a Web-based knowledge exchange intervention was influenced by a number of individual and contextual factors. Differences in these factors and preferences for knowledge sources require further characterization to enhance engagement of rural ED clinicians in online knowledge exchange interventions.

Key words: Canada, information technology, knowledge exchange, pediatric emergency medicine, survey.

Introduction

In recent decades there has been a call to action for the development of quality and safety indicators for pediatric emergency care^{1,2}. The use of best practice knowledge (inclusive of research evidence, clinical judgment and patient information) is key in the delivery of quality care. In a busy pediatric emergency department (ED), the complexity of patient care, focus on patient flow, availability of resources, and the interruptive nature of the practice environment create less than ideal conditions for consistent use of best practice knowledge³. Further challenges exist in smaller rural EDs where workforce skill mix, limited patient volume and acuity (which minimize repetition of procedures such as resuscitation), and limited resources (eg access to continuing education because of clinical coverage or distance) can restrict exposure to best practice knowledge^{4,6}. Recent studies report only 2.4% of Canadian specialist physicians are located in rural and small towns (communities with small populations and geographically distant from urban centers) where 21.1% of the population resides⁷. Rural EDs, where half of all emergency care in Canada is delivered, rely heavily on family physicians to staff departments⁸. Over 80% of children are seen in rural EDs^{5,8}. Given rural Canadians have poorer outcomes from acute medical illness and injury, innovative strategies are needed to strengthen

access to best practice knowledge in these complex practice environments^{5,8}.

Knowledge exchange is understood to be a two-way flow of ideas, best practice knowledge, and experience between members in a community of practice^{9,10}. In the healthcare literature, knowledge exchange generally focuses on the sharing of research knowledge between researchers and knowledge users (eg clinicians and policy makers)¹¹. A feature common to all perspectives on knowledge exchange is the importance of a social process that involves knowledge sharing between individuals or groups^{12,13}. To date, research focused on knowledge exchange between rural and urban emergency practice settings is limited.

Three key dimensions have been identified across a range of studies as important in knowledge exchange: characteristics of the individual; context of practice; and knowledge. Individual clinicians are the gatekeepers to the flow of knowledge in practice and play a central role in knowledge exchange. Knowledge, skills, attitudes, beliefs and behaviors of individual clinicians influence the extent to which they use and share knowledge¹⁴⁻¹⁷. The context in which knowledge is used and shared in health care can influence the development of an evidence-based practice environment¹⁸⁻²⁰. The context of practice in this study is understood to mean the social, cultural, structural and material elements of the setting or



environment where emergency practice occurs. Finally, the characteristics of the knowledge (relevance, complexity, availability and compatibility) have implications for its mobility and efficiency in practice²¹⁻²⁵. Knowledge in this study is focused on best practice knowledge in pediatric emergency care arising from multiple ways of knowing.

To better understand how these dimensions influence knowledge exchange in rural and urban emergency practice settings, a follow-up survey of emergency clinicians who were invited to participate in a Web-based knowledge exchange intervention, the Pediatric Emergency Care Web Based Knowledge Exchange Project, was conducted. This knowledge exchange intervention was a password-protected website open to clinicians from nine rural and two urban EDs. The website contained 12 pediatric emergency practice learning modules with linked asynchronous discussion forums. The topics for the modules were determined through a needs assessment and module content was developed by known experts in the field. Additional details regarding the website and the primary outcomes of the project are presented elsewhere^{26,27}. This article presents the results of a survey that sought to identify factors relevant to the decision made by rural and urban emergency clinicians to participate in a Web-based knowledge exchange intervention. In the context of this project, knowledge exchange refers to the seeking and sharing of all types of healthcare knowledge for the benefit of clinicians, researchers, administrators, patients and society at large.

Methods

Participants and sampling

Study participants ($n=187$) were clinicians from the 11 EDs who agreed to participate in the Pediatric Emergency Care Web Based Knowledge Exchange Project. This included 32 physicians, 146 nurses and nine pharmacists working in nine rural and two urban EDs in one province in Canada. In the context of this study, rural (regional and community) EDs served a catchment of fewer than 100 000 people. Ten of the 11 EDs had an affiliation with a provincial academic institution. All the departments, with the exception of one, operated 24 hours per day, seven days per week. Six of the

10 had single physician coverage for the evening and night hours and five of the EDs were staffed by family physicians. All study participants had Internet access in their ED.

Survey development

The following questions guided the development of a self-administered survey: (i) What are the individual, context of practice or knowledge factors which impact a clinician's decision to participate in a Web-based knowledge exchange intervention?; (ii) What are clinicians' perceptions of organizational expectations regarding knowledge and information sources to be used in practice?; and (iii) What are the preferred knowledge sources of rural and urban emergency clinicians? The survey was designed to capture data related to the three dimensions of interest in this study (individual, context of practice and knowledge). A minimum of four items were developed for each dimension. Items in the individual dimension captured information about knowledge exchange beliefs, behaviors and activities. Items included under the context of practice dimension explored knowledge exchange structures and processes that were outside the control of the individual clinician. Items included in the knowledge dimension reflected activities and behaviors relevant to the use of Web-based technology for knowledge exchange. Responses were scored on a 4-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). A panel of five emergency practice content experts (two physicians, three nurses) reviewed the survey for face validity. Minor revisions were made to wording in four survey items based on this expert feedback. Demographic data regarding each participant's age, gender, discipline, years of emergency experience, additional education and certification achieved, computer literacy and practice location were also captured. The two-page survey took approximately 10 minutes to complete.

Survey administration

The Pediatric Emergency Care Web Based Knowledge Exchange Project occurred between February 2004 and December 2005. Data collection for this survey study occurred between January 2006 and March 2006. Surveys were mailed to the study site coordinators at each of the 11 sites for distribution to study



participants via the internal health center mailing system. Site coordinators were instructed to send out one reminder email to all participants 2 weeks after the initial distribution. Each survey package included a letter of instruction directing the participant to return the completed survey to the site coordinator in the sealed envelope provided in the survey package. Each site coordinator was provided with a postage paid envelope to return completed surveys to the principal investigator.

Data analysis

Survey item responses were entered in Statistical Package for Social Sciences v15 (SPSS Inc; www.spss.com). Data were checked and cleaned through examination of frequency distributions and crosstabulations to highlight data entry errors, missing data and outliers. Missing data were replaced by item mode when less than 5% of item data was missing. Descriptive statistics (mean, mode, standard deviation and quartile range) and stem-leaf plots were generated for all items. Internal consistency (reliability) of the survey tool was checked using Cronbach's alpha. Chi-squared and Fisher's exact test were used to determine if there was a relationship between individual items in the three dimensions (individual, practice context and knowledge) and the participant's decision to take part in the knowledge sharing intervention. Mann-Whitney *U*-test was used to determine if there was a difference between rural and urban clinicians' perceptions of organizational expectations regarding knowledge use or preferred sources of knowledge.

Ethics approval

The Institutional Review Boards at all participating IWK Health Centre sites approved the protocol (approval ##3611). Written informed consent was obtained from all participants.

Results

Demographic characteristics

A total of 107 surveys were returned, although two surveys with only demographic sections completed were removed,

resulting in a 56% (105/187) return rate. The majority of respondents were nurses (87/104, 84%, one missing) and slightly more than half were from rural settings (59/105, 56%) (Table 1). This distribution is similar to the demographic distribution of the sampling frame ($n=187$, 17% physicians, 42% urban). Seventy-four percent of respondents were between the ages of 31 and 50 years. The majority of respondents (63/104, 61%) did not have emergency certification in nursing or medicine and 43% of respondents had greater than 10 years of experience in emergency practice.

The reliability of the 23 item scale was strong (Cronbach's $\alpha=0.841$). The subscales, as planned during survey development, also demonstrated good or strong internal consistency (context of practice, $\alpha=0.755$; individual, $\alpha=0.693$; knowledge, $\alpha=0.786$).

Resource use

The majority of respondents reported adequate access to a number of explicit (text-based) knowledge sources but access to a librarian to assist with using these resources was limited (Table 2). More than 50% of respondents reported adequate access to paper journals (57/105 or 54%) and online journals (68/105 or 65%), but less than half reported using these resources to address questions arising in practice (paper journals, 37%; online journals, 30%). Participants reported relying on physicians (92%) and nurses (69%) from their own ED as primary sources of knowledge about pediatric emergency care. There was limited (nurses, 16%; physicians, 17%; pharmacists, 13%) consultation with clinical experts from other EDs as a source of knowledge to guide practice. In addition to personal sources of knowledge from their own department, participants also reported relying on clinical practice guidelines to guide practice (93/105 or 89%). Expectations regarding the use of knowledge from both research evidence (79/105 or 75%) and clinical experience (94/105 or 89%) to guide practice were also reported by the majority of respondents.



Table 1: Demographic characteristics of survey respondents

Demographic characteristic		N (%) n=105
Age (years) (missing=1)	20-30	8 (8)
	31-40	37 (36)
	41-50	37 (36)
	51-60	20 (19)
	61-70	2 (2)
Setting	Rural	59 (56)
	Urban	46 (44)
Discipline (missing=1)	Physician	17 (16)
	Nurse	87 (84)
Gender (missing=1)	Male	15 (14)
	Female	89 (86)
Advanced Emergency Certificate Training (missing=1)	Yes	38 (37)
	No	66 (64)
Years ED experience (missing=4)	<1	1 (1)
	1-3	14 (13)
	4-6	30 (29)
	7-9	11 (11)
	>10	45 (43)

ED, Emergency department.

Individual survey item scores were then dichotomized and χ^2 was used to explore the relationship between individual survey items and the outcome variable (participation). There was a relationship between participation in the knowledge exchange intervention and two items in the individual dimension (I consult with nurses outside of my ED, I am actively involved in research) and one item from the context dimension (In our ED we are expected to use research to guide practice) (Table 3).

A comparison of rural and urban clinicians' preferred knowledge sources reveals that clinicians are generally similar with the exception of the use of research to guide practice and reliance on physicians as a source of clinical practice knowledge (Table 4). A significantly larger percentage of urban clinicians indicated that they use research evidence to guide practice and they rely on physicians in their own ED to guide practice.

Discussion

Individual, context of practice and knowledge factors affecting participation

Less than half (43%) of the survey respondents participated in the Web-based knowledge exchange intervention, which was intended to link clinicians from rural and urban EDs to share knowledge related to pediatric emergency care. Review of the survey items would suggest that survey respondents rely heavily on peers (nurses 69% and physicians 92%) from their own ED for knowledge to guide their practice and are less inclined to use personal sources from other EDs or explicit sources such as paper journals or online journals. These results are similar to study findings from other practice settings²⁸⁻³⁰. The sharing of expert practice knowledge through discussion of exceptional or rare presentations by ED clinicians has the potential to become valued propositional knowledge through a process of debate, discussion and verification of the evidence by the community of practitioners who participate. However, the value of this type of knowledge exchange is limited in EDs where there are few clinicians with advanced emergency training and inadequate use of explicit knowledge sources.



Table 2: Survey items' descriptive statistics

Item	Agree/Strongly agree (N=105) n (%)	Mode†
I have adequate access to a library in my health center.	56 (53)	3
I have adequate access to a librarian to assist me with finding information related to emergency practice.	42 (40)	1
I have adequate access to paper journals in emergency care in my health center.	57 (54)	3
Staff in our ED rely on clinical practice guidelines and protocols to guide practice.	93 (89)	3
In our ED, we are expected to use research evidence to guide our practice.	79 (75)	3
In our ED, we are expected to use clinical evidence to guide our practice.	94 (89)	3
Our ED is actively involved in research related to emergency practice.	48 (45)	2
Over the past two years I have had adequate access to continuing education opportunities (other than this web-based study) related to pediatric emergency care.	54 (51)	3
My team meets on a regular basis (at least monthly) to discuss new research and/or proposed changes to clinical practice in our ED.	31 (29)	2
I rely on nurses from my ED as a source of knowledge about pediatric emergency care.	72 (69)	3
I rely on physicians from my ED as a source of knowledge about pediatric emergency care.	97 (92)	3
I rely on pharmacists from my health center as a source of knowledge about pediatric emergency care.	33 (31)	2
I rely on the nurse manager in my ED as a source of knowledge about pediatric emergency care.	28 (27)	2
I rely on the medical director/senior physician of my ED as a source of knowledge about pediatric emergency care.	59 (62)	3
I consult with physicians from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	18 (17)	2
I consult with nurses from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	(17) 16	2
I consult with pharmacists from other health care organization on medication issues related to pediatric emergency care.	(14) 13	2
I use paper journals on a regular basis (at least monthly) to address questions I have related to patient care.	39 (37)	2
I am actively involved in research related to emergency practice.	34 (32)	2
I use bibliographic databases (Pubmed, Medline, CINAHL or Cochrane Library) on a regular basis (at least monthly) to find literature to address questions I have related to pediatric emergency care.	23 (22)	2
I have adequate access to a computer with an internet connection in my clinical area.	78 (74)	3
I use online journals on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	32 (30)	2
I have adequate access to online journals in emergency care in my health center.	68 (65)	3

ED, Emergency department.

†1=Strongly disagree, 4 = Strongly agree.

Geographical boundaries have been shown to influence the social networks of nurses and physicians³¹. The Web-based knowledge exchange intervention was intended to minimize geographical boundaries and provide participants with an opportunity to engage in discussion with clinicians from outside of their own ED. In an earlier paper comparing emergency clinicians' online and offline knowledge exchange behaviors, a social network analysis revealed a significantly higher number of knowledge exchange opportunities in an online environment²⁶. In the present study, the practice of consulting personal knowledge sources from other EDs (individual dimension) was found to be significantly related to decision to participate in the Web-based knowledge exchange intervention ($\chi^2=6.369$, $p=0.012$). Linkages between EDs are

important for the exchange of new knowledge. Weak ties between groups (groups that have some connection but do not spend a lot of time together) have been identified as important for spreading new ideas and scientific information³². Although most weak ties serve no function, they can serve as a crucial bridge between different densely knit networks and allow novel ideas and new information to be introduced³³. Emergency departments with few or no weak ties will be deprived of knowledge from other rural or urban centers. While the Web-based knowledge exchange intervention created the opportunity for clinicians to share information, additional strategies may have been needed to formally establish ties between EDs to start the flow of knowledge exchange.



Table 3: Relationship between survey items and participation in Web innovation

Item	Dimens.	Agree/Strongly agree		Mode		X ²	P-value
		Participate		Participate			
		Yes (n=45)	No (n=60)	Yes	No		
I consult with nurses from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	Individual	12	5	2	1	6.369	0.012
I am actively involved in research related to emergency practice.	Individual	20	14	2	2	5.234	0.019
In our ED, we are expected to use research evidence to guide our practice.	Context	39	40	3	3	5.521	0.015

Dimens., Dimension; ED, emergency department. .

Table 4: Comparison of rural and urban clinicians' preferred knowledge sources

Knowledge source	Agree/ strongly agree % (n)		Z-score
	Rural (n=59)	Urban (n=46)	
In our ED we are expected to use research evidence to guide practice.	64 (38)	89 (41)	-3.796**
Our ED is actively involved in research related to emergency practice.	18.6 (11)	80.4 (37)	-6.243**
In our ED we are expected to use clinical evidence to guide practice.	90 (53)	89 (41)	-1.934
Staff in our ED rely on clinical practice guidelines to guide practice.	88 (52)	89 (41)	-0.691
I consult paper journals to address practice questions.	39 (23)	35 (16)	-0.160
I consult online journals to address practice questions.	27 (16)	35 (16)	-1.308
I consult bibliographic databases to find literature to answer clinical questions.	22 (13)	22 (10)	-0.318
I rely on nurses from my own ED as a source of knowledge.	65 (38)	74 (34)	-1.534
I rely on physicians from my own ED as a source of knowledge.	90 (53)	96(44)	-2.033*
I consult nurses from other EDs as a source of knowledge.	19 (11)	13 (6)	-0.313
I consult physicians from other EDs as a source of knowledge.	19 (11)	15 (7)	-0.341

ED, Emergency department.

* $p < 0.05$; ** $p < 0.001$.

Two other items that were found to be significantly related to participation in the Web-based knowledge exchange intervention were personal involvement in research activities (individual dimension) ($\chi^2=5.234$, $p=0.019$) and perception of organizational expectation to use research evidence to guide practice (context dimension) ($\chi^2=5.521$, $p=0.015$). Participation in research activities has been associated with

research use in practice^{34,35}. Less than half of survey respondents indicated they were personally involved in research or that their ED was involved in research. It is possible that a lack of exposure to or experience with research initiatives may have contributed to the moderate participation rate in this knowledge exchange intervention. The Web-based intervention provided clinicians with



exposure to best practice knowledge through pediatric emergency specific learning modules and a discussion forum. Clinicians have demonstrated a willingness to use online evidence at the point of care to fill in gaps in their practice knowledge; however, adequate training and supportive leadership have been identified as important factors in optimizing the process^{36,37}. Overt strategic initiatives and support from management are necessary to permeate the boundaries that inhibit the development of social relationships and consequently knowledge sharing between communities³⁸. Organizational expectations regarding the use of research evidence to guide practice was related to participation in the knowledge exchange intervention in the current study. Engaging ED policymaker/administrative stakeholders in setting research priorities may assist with participation in future knowledge exchange interventions³⁹.

Practitioners' perceptions of organizational expectations regarding use of knowledge

Organizational context has been identified as an important factor in knowledge exchange and best practice^{30,40}. Overall, 75% of survey respondents reported that they were expected to use knowledge from a variety of sources (clinical practice guidelines, research evidence and clinical evidence) to guide their practice. Yet, only 37% reported using paper journals, 30% reported using online journals and 22% reported using bibliographic databases on a regular basis. In addition, only 43% chose to participate in a knowledge exchange intervention that presented best practice knowledge relevant to rural and urban emergency practice settings. Intraorganizational and interorganizational networks that have been established around a common practice are useful for spreading knowledge among practitioners⁴¹. Collaborative technologies such as electronic discussion boards have been shown to facilitate knowledge sharing among time-challenged and geographically dispersed rural and urban practitioners⁴². However, there is a pressing need for organizations to identify strategies and processes that support and encourage individuals to openly and freely share their practice knowledge⁴³.

There was a significant difference ($p < 0.001$; $Z = -3.796$) between rural and urban clinicians' perceptions of organizational expectations regarding use of research evidence to guide practice. This difference may have been due to the lower volume of research activities in rural settings. Recent initiatives demonstrate new opportunities for community EDs to participate in research activities⁴⁴. For example, Translating Emergency Knowledge for Kids is a Canadian knowledge mobilization initiative that is building capacity through partnerships and exchange among 30 general emergency departments across Canada and members of Pediatric Emergency Research Canada (PERC), Pediatric Emergency Research Networks (PERN, an international collaborative) and Knowledge Translation Canada⁴⁴. Practice contexts that embody characteristics of a learning organization have been identified as important in the literature on knowledge exchange in healthcare environments⁴⁵. Activities such as journal clubs, regular team meetings or an active program of research create opportunities to discuss knowledge in the context of local practice and are reflective of a practice culture that values knowledge. Organizations need to demonstrate their value and commitment to knowledge exchange through formal structures and process. According to survey participants, structures to support seeking and sharing of explicit or external knowledge sources were limited. Only 29% of respondents indicated opportunities to participate in discussion about new research or proposed practice change in their ED and 60% felt that they did not have adequate access to a librarian to assist with finding new information related to their practice. Less than half (45%) of survey respondents indicated that their ED was actively involved in research. Clinicians recognize the importance of best evidence to guide practice; however, a lack of organizational infrastructure and resources to support knowledge sharing activities may influence clinicians' willingness to engage in a knowledge exchange intervention.

Preferred knowledge sources of rural and urban practitioners

Published studies exploring the information needs of health professionals suggest that rural health practitioners have the same patient-care information needs as their urban counterparts⁴⁶. In general, rural and urban emergency



clinicians in this study presented a similar preference pattern for knowledge resources: although external colleague sources were the least likely to be used, internal colleague sources, particularly physician sources, from their own ED were the most highly used resource. Tapping into organizational knowledge stored in social networks for decision making is well described in the organizational learning literature⁴⁷. Explicit sources in the form of bibliographic databases and paper and online journals were used minimally in both rural and urban settings; however, clinical practice guidelines were identified as a valuable explicit source for both groups. This pattern is similar to that shown in other studies exploring knowledge sources of rural and urban clinicians⁴⁸; that is, peers or colleagues are more highly valued knowledge sources than explicit, text-based sources⁴⁹. However, the current study contributes new information regarding personal knowledge sources of rural and urban EDs. It is known that smaller rural centers have limited expert personal sources of knowledge⁵⁰. In many smaller EDs family practice clinicians, with little or no formal emergency specialty training, provide medical coverage for emergency services and may not actually be onsite 24 hours per day. This may account for the significant difference ($p < 0.05$; $Z = -2.033$) between the two groups in their reliance on physicians as a source of knowledge. In addition, results from the current study reveal that the use of personal sources of knowledge from other EDs to guide practice was limited. This suggests the flow of new knowledge between EDs may be limited and is an important knowledge exchange gap for under-resourced, smaller EDs. The Web-based knowledge sharing intervention in this study was intended to bridge geographically dispersed EDs and connect smaller communities of practice for knowledge exchange. There is a need to identify strategies to enhance the use of this resource.

A significantly greater ($p < 0.001$; $Z = -3.796$) number of urban clinicians reported use of research evidence to guide practice compared to their rural counterparts. This is an interesting finding considering both groups have similar patterns in their use of explicit knowledge sources. However, the difference may be attributed to the significantly higher volume of research activities reported in the urban centers

($p < 0.001$; $Z = -6.243$) versus the rural centers. This finding would support the notion that participation in research activities is associated with research use in practice³⁵.

Limitations

There are several limitations of this work that require consideration. This study was based on self-report measures, which are subject to bias⁵¹. Responder bias could not be ascertained due to limitations of the demographic data collected. Although the survey was pilot tested for face and content validity, it requires further psychometric evaluation.

Multiple comparison adjustments were not made during data analysis. However, it has been argued that adjustments are not necessary when there is a strong basis for expecting a difference in groups⁵². Differences in the availability of resources in rural and urban settings are well documented in the emergency practice literature; therefore, there was a prior expectation for finding a difference in resource use. Although physician-double coverage in rural EDs is limited, particularly on evenings and weekends, this data was not collected. It is possible double-coverage could have affected physicians' consultation rate with outside ED clinicians. Finally, although the survey showed good reliability, it will benefit from further testing with a larger sample size and adjustment for multiple comparisons.

Conclusion

Regional support and additional educational resources are important for the recruitment and retention of rural clinicians⁵³. Creating opportunities for knowledge exchange and enhancing research capacity is important for a number of reasons, including the potential for improving effectiveness and efficiencies in care towards optimizing patient outcomes. The study results revealed that participation in a knowledge exchange intervention was related to consultation with colleagues from other EDs, personal involvement in research activities and organizational expectation for the use of research evidence to guide clinical practice. Rural and urban



clinicians in this study presented a similar preference pattern for particular knowledge resources, although they differed in their perceived organizational expectations for using research evidence to guide practice. External personal sources were the least likely to be used and personal sources from their own ED were the most highly used resource. Explicit sources in the form of bibliographic databases and paper and online journals were used minimally in both rural and urban settings. Overall, the majority of respondents identified organizational expectations to use multiple types of knowledge (clinical practice guidelines, research evidence and clinical evidence) to guide practice. The three dimensions (individual, context of practice and knowledge) provided a practical framework for the development of an evaluation survey for the Pediatric Emergency Care Web Based Knowledge Exchange Project. Results from this survey may provide useful information for emergency practice educators, researchers and administrators interested in facilitating Web-based knowledge exchange within and between rural and urban emergency practice settings.

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