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Abstract

The objectives of this study were to present a short history of the Critical Care Research Network (CCR-Net), describe its approach to health services research and to summarize completed and current research projects. In doing this, we explored the question is this research network accomplishing its goals? We reviewed the medical literature to identify studies on similar types of Networks and also the evidence supporting the methodology used by CCR-Net to conduct research using MEDLINE, HEALTHSTAR, CINAHL and the keywords *network* and *health care* or *healthcare*, *benchmarking* and *health care* or *healthcare*, and *research transfer* or *research utilization*. We also reviewed the bibliographies of retrieved articles and our personal files. In addition, we summarized the results of studies conducted by CCR-Net and outlined those currently in progress. A review of the literature identified studies on two similar networks that appeared to be succeeding. In addition, the literature was also supportive of the general process used by CCR-Net, although the level of evidence varied. Finally, the studies conducted to date within CCR-Net follow the suggested methodology. At the time of this preliminary communication CCR-Net appears to have adopted a valid approach to health services research within the area of Critical Care Medicine. Further direct evidence is required and appropriate studies are planned.

Background

In Canada, the National Forum on Health recently advocated both an evidence-based approach to healthcare and the need to establish common databases to describe the current process of healthcare (Watanabe & Noseworthy 1997). Similarly, the Ontario Provincial Co-ordinating Committee on Community and Academic Health Science Relations (PCCCAR) advocated the development of *Academic Health Sciences Networks* (AHSN) (PCCCAR

Reports 1995). The goals of these Networks are to establish links between academic centres and community hospitals to foster improvement in research transfer and the effectiveness and efficiency of health care. Despite the recent popularity of research networks (Keenan & Martin 1998), little work has been published assessing their effectiveness: are they accomplishing what they set out to accomplish?

The Critical Care Research Network (CCR-Net), a group of academic and community intensive care units (ICUs) in Ontario and Newfoundland, was

established to 'improve service co-ordination, communications linkages, patient transportation, guidelines and availability of data on resources and utilization' (Sibbald & Calvin, 1991). The initial objectives of CCR-Net were (Watanabe & Noseworthy 1997): to establish and maintain a registry of both the structure and activity of critical care facilities, the resources used and outcomes achieved (PCCCAR Reports 1995); to develop data analysis and reporting mechanisms to describe, compare and evaluate current activities, case-mix and peer hospital level, and (Keenan & Martin 1998) to develop specific protocols to examine and improve patient outcome and reduce resource utilization in critical care facilities. The objectives of this paper are to present a short history of CCR-Net, describe its approach to health services research, and to summarize completed and current research projects.

The history of CCR-Net

CCR-Net was initiated in 1993 as the South-western Ontario Critical Care Research (SOCCR) Network. An inaugural conference was held in London, Ontario in Spring 1994, attended by healthcare workers from South-western Ontario involved in caring for critically ill patients. The purpose of this conference was to identify those areas of care for critically ill patients that were of greatest concern to health care workers. These conferences have continued on an annual basis. Following the initial meeting, 8 ICUs agreed to begin collecting data on their admissions. The number of ICUs involved has continued to grow and currently there are 27 ICUs collecting data on all ICU patient admissions (age, admitting diagnosis, the Acute Physiology and Chronic Health Evaluation [APACHE] III physiology parameters (Knaus *et al.* 1991), source of admission and patient outcome). The name of this network was changed in 1997 to CCR-Net, to reflect a growing participation by hospitals outside the South-western Ontario region. The Network receives funding support from a variety of sources including initial core funding from a private funding body, the University of Western Ontario and the London Health Sciences Centre. In addition, funding has been received for specific research projects from peer-review funding agencies and industry.

CCR-Net's approach to research

At the initial CCR-Net meeting, critical care processes were identified as requiring further study due to either a lack of sufficient evidence in the literature to guide the process (Watanabe & Noseworthy 1997), or concerns that practice was not optimal despite the presence of sufficient evidence (PCCCAR Reports 1995). Working groups were created to look into issues specific to the following care processes: nutrition, mechanical ventilation, withdrawal of life support, emergency admissions and long stay patients. In 1997, a seven-step model was created that formally described an evolving methodology used by CCR-Net to meet the needs of its membership (see Fig. 1).

Evaluation of CCR-Net

How does one assess the validity of a network? To determine whether a network is fulfilling the needs of its members, those best able to judge this are the members themselves. Each year members of CCR-Net provide feedback on Network research projects at the annual meeting and help guide the future directions of these projects through discussions at specific project sessions. In addition, we plan to conduct a formal assessment of member satisfaction with their Network membership in the near future. Through this survey we hope to encourage members to reflect on the direct benefits they feel they have gained through membership, potential benefits that are not being realized and suggestions for changes to improve satisfaction levels. Since a primary function of the Network is data collection, we undertook a specific project to evaluate this process. Re-abstraction of admission, discharge and illness severity data found good agreement within each site (Chen *et al.* 1999).

An alternative approach to assessing network validity is to review the literature. Identifying studies describing similar types of networks and their outcomes – member satisfaction, improved level of patient care and improved patient outcomes, would all suggest a valid process. Wirtschafter and colleagues described a network of 10 neonatal intensive care units in Southern California (Wirtschafter *et al.* 1994) who adopted a similar approach to that used by

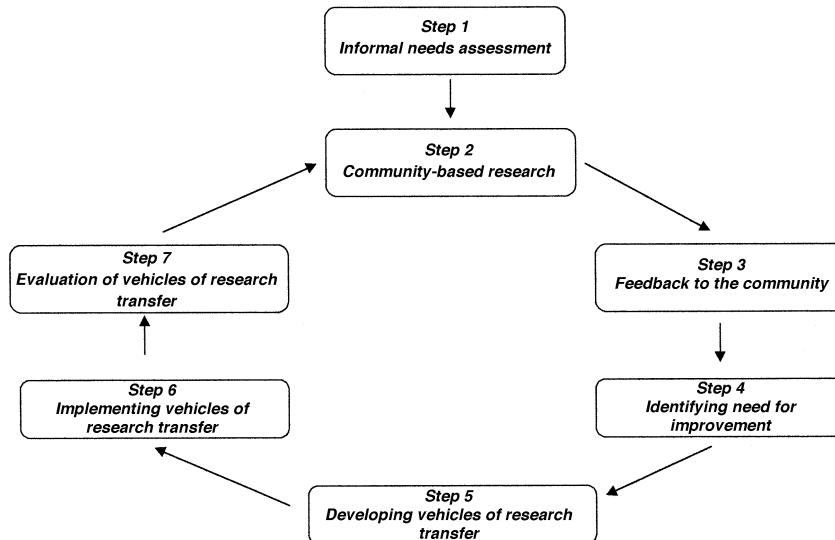


Figure 1 This figure describes the approach used currently by the Critical Care Research Network (CCR-Net) to conduct its research projects in the varied care areas of the critically ill patient. It has been expanded from the original four questions of the quality loop to seven steps to allow it to more fully describe the operations of CCR-Net.

CCR-Net. From the literature, they identified data to collect describing a process of patient care and then benchmarked (Campbell 1994; Keenan *et al.* 1997) their ICUs to both each other and the literature. Variation in practice and outcomes were carefully determined and factors responsible for variability were identified. Modifications were made as necessary leading to a decrease in practice and outcome variability and resulting in a uniformly higher overall quality of care. Maag and associates described a similar network of nine hospitals who worked together to assess emergency room treatment of patients with chest pain (Maag *et al.* 1997). Variation in admission rates and practice patterns were documented and best practice was then identified and summarized in a monograph. The monograph was

piloted at one centre and is planned for implementation in the remaining centres. These encouraging results indirectly support the validity of the process used by the CCR-Net.

Finally, the approach used by CCR-Net (outlined in Fig. 1) can be evaluated by summarizing the degree of support found for each step in the relevant literature. To determine the validity of each step, we assessed the evidence in the literature for each step individually and reviewed how closely each step had been followed by the Network in its varied projects (see Table 1). We made the assumption that if all steps are valid individually (i.e. the literature supports that they accomplish what they set out to accomplish), then the entire proposed process is also valid. Furthermore, if the current projects can be

Table 1 Level of evidence available for each of CCR-Net's steps

<i>Step in pathway</i>	<i>Level of evidence</i>
Step 1 – Informal needs assessment	Level 5 (Expert Opinion)
Step 2 – Community-based research	Level 5 (Expert Opinion)
Step 3 – Feedback to the community	Level 5 (Expert Opinion)
Step 4 – Identifying need for improvement	Level 5 (Expert Opinion)
Step 5 – Developing vehicles of research transfer	Level 1 (Systematic review of RCTs)
Step 6 – Implementing vehicles of research transfer	Level 1 (Systematic review of RCTs)
Step 7 – Evaluation of vehicles of research transfer	Level 1 (Systematic review of RCTs)

demonstrated to be following these steps, completing the process should result in useful community-based research and research transfer.

Step 1. Informal needs assessment

Areas of highest priority to decision-makers can be identified by conducting an assessment of the needs of healthcare practitioners (Jones & Spencer 1993; Hunt 1996; Lambo 1995; Nutbeam 1996). Research designed to forward scientific understanding alone, while of paramount importance, may not be useful or used by practitioners. Effective research transfer (the process of transferring the results of research from the researchers to the proposed end-users) must be developed to benefit decision-makers and researchers alike.

Step 2. Community-based research

Involving individuals from the community in the research process (study design, data collection, analysis and interpretation) is an essential ingredient for research transfer (Thomson *et al.* 1995; Wise & Billi 1995; Greco & Eisenberg 1993; Kibbe *et al.* 1994; McGuire 1992). Local participation encourages ownership and advocacy of research results by the decision-maker. While 'participatory research', involving a specific community or network, may have problems of generalization, it provides meaningful results for those involved (Green & Johnson 1996).

Step 3. Feedback to the community decision-makers

Providing timely feedback to community hospitals regarding their ongoing projects is an important method for maintaining interest in the projects and reinforcing or discouraging certain activities. Because feedback incorporates an educational component with personal achievement data, it is an effective method for both personalizing the data and for encouraging ongoing participation in projects (Green & Johnson 1996; Eisenberg & Williams 1981).

Step 4. Identifying need for improvement

Providing feedback to member hospitals, describing their current practice and that of their peers, can

identify potential areas for improvement in the delivery of health services. To effectively alter practice, however, the feedback must be presented in a manner that enables subjects to recognize their individual need for change (Greco & Eisenberg 1993). That is, the information about an individual hospital's current practice must be benchmarked against the practice of peers or against research evidence.

Step 5. Developing vehicles of research transfer

The transfer of research results into decisions is facilitated when results are presented as evidence-based clinical practice guidelines (Davis *et al.* 1992; Davis *et al.* 1995; Oxman *et al.* 1995; Davis & Taylor-Vaisey 1997; Crane 1995; Chassin 1990s). Evidence-based clinical guidelines are a synthesis of the best currently available evidence for a particular clinical situation. By providing research-based descriptions of situation- and patient-specific appropriate care, they are used to assist practitioners' and patients' decision-making processes (Thomson *et al.* 1995). Practitioners are more inclined to give consideration to synthesized information, such as practice guidelines, than to an abundance of primary research documents (Lomas 1993). To create useful guidelines that are ultimately adopted by the appropriate decision-makers, the decision-makers should be included in the process of guideline development (Greengold & Weingarten 1996).

Care maps (Canadian Medical Association 1995) are another vehicle of research transfer. While clinical practice guidelines are directed at a specific decision-making process in patient care (such as determining the optimal time to convert from intravenous to oral antibiotics (Weingarten *et al.* 1994) or deciding when to admit patients to a coronary care unit (Weingarten *et al.* 1993)), care maps describe a more complete approach to a patient care process (Canadian Medical Association 1995). Care maps are focused at high volume case-mix groups with relatively predictable courses, such as men admitted for transurethral resection of the prostate (Canadian Medical Association 1995). Aside from some high-risk patient groups such as vascular and cardiovascular patients, most patients admitted to intensive care units do not follow easily predictable courses.

As a result, care maps in their original format are not well suited to most intensive care unit patients.

Step 6. Implementing vehicles of research transfer

High quality, evidence-based clinical practice guidelines can improve healthcare delivery only if those guidelines are implemented, and thus used as intended (Lomas *et al.* 1989). To maximize effectiveness, guideline implementation strategies are necessary (Eisenberg & Williams 1981; Davis *et al.* 1992; Davis *et al.* 1995; Oxman *et al.* 1995; Davis & Taylor-Vaisey 1997). The most effective method for changing practice behaviour is the introduction of more than one guideline implementation strategy (Greco & Eisenberg 1993; Eisenberg & Williams 1981; Davis *et al.* 1992; Davis *et al.* 1995; Oxman *et al.* 1995; Davis & Taylor-Vaisey 1997).

Step 7. Evaluation of vehicles for research transfer

Evaluating clinical guidelines after implementation is critical to determine whether both the guideline itself and its implementation were effective. Very few research transfer strategies have been evaluated to date, and each evaluation of an evidence-based clinical guideline (Davis *et al.* 1992; Davis *et al.* 1995; Oxman *et al.* 1995; Davis & Taylor-Vaisey 1997; Weingarten *et al.* 1994; Weingarten *et al.* 1993; Hay *et al.* 1996) brings us closer to understanding how best we can transfer the results of high quality research to the bedside.

Specific research projects of CCR-Net

While definitive studies are lacking, effective feeding of critically ill patients, including timing and route of feeding, is believed to influence patient outcome (Heyland 1998). As a result of concerns among the dieticians of member hospitals, an initiative was established to study current feeding practices. A multi-centre cohort study was undertaken to determine current feeding practices at interested member hospitals. From this preliminary work, it was apparent that all participating Network hospitals were initiating feeding later than desirable, resulting in lower total feeds ingested. Having identified nutrition as a problem by benchmarking the hospi-

tal's performances against each other and the literature, steps were taken to improve the situation. A committee was created to develop a clinical practice guideline for feeding ICU patients. The committee was comprised of physicians and dieticians from both academic and community centres. An epidemiologist prepared a systematic review of the literature and acted as a facilitator at the meeting of committee members where a guideline, combining evidence from the literature and the expertise of end-users, was developed. To combine implementation of the clinical practice guideline with its evaluation, 14 centres participated in a cluster randomized controlled trial, seven centres receiving the guideline and seven other centres continuing current practice. Implementation of the guideline used multiple strategies, as this approach has been found to achieve better results than one strategy alone (Greco & Eisenberg 1993; Eisenberg & Williams 1981; Davis *et al.* 1992; Davis *et al.* 1995; Oxman *et al.* 1995; Davis & Taylor-Vaisey 1997). Local opinion leaders conducted continuing education sessions at each hospital, reinforced by written materials. In addition, academic detailing by in-hospital educators of practitioners responsible for using the guideline was conducted on a one-on-one basis within each institution. Data analysis to evaluate the introduction of this guideline is just underway. Compliance with the guidelines will be determined and the effect on feeding practice will be analysed in two ways. First, a comparison of clinical outcomes and feeding practices will be made between the centres receiving the guideline and those that did not, and second, a before and after comparison will be conducted within hospitals receiving the guideline (each centre documented baseline practice during a run-in period prior to guideline implementation). Using this approach, we will determine whether implementation of this feeding guideline has resulted in a measurable, beneficial change. If this is the case, the guideline will be promoted for implementation in all Network ICUs. Ongoing evaluation of compliance with the guideline should be carried out periodically in the future. In addition, modifications to the guideline will be made as necessary as new evidence arises in the literature. Following these modifications, further evaluation will be necessary to ensure compliance and determine the effect on patient outcomes.

Initiatives similar to that of the nutrition group have begun in the areas of the withdrawal of life support (WLS) in the ICU, mechanical ventilation, care and outcome of long-stay ICU patients, and admission practice from the emergency department. Re-admissions to the ICU were examined using the database (Chen *et al.* 1998), leading to a change in practice and process by some member hospitals. Withdrawal of life support (WLS) practice was studied in a prospective cohort study of nine ICUs (three teaching and six community hospitals) and differences were found among ICUs in the proportion of patients dying following withdrawal of life support (Keenan *et al.* 1998). Differences in process were also identified, including person initiating discussion of WLS, timing of WLS and time to death following beginning of WLS. A follow-up study addressing current satisfaction levels with the process of withdrawing life support has documented differences among ICUs in both nurse and respiratory therapist satisfaction levels (Keenan *et al.* 1999). These small area variations (Birkmeyer *et al.* 1998; Lu-Yao *et al.* 1993; Welch *et al.* 1993) identify a potential for improvement in patient care during WLS. Further study will focus on both assessing the family perspective and considering the development, implementation and evaluation of a guideline on how to withdraw life support once the decision has been made to discontinue aggressive care.

Plans are underway to study other ICU care processes in the same manner. Surveys of ventilation practice and decision-making in admitting emergency department patients to the ICU have been completed and prospective data collection, to describe practice more fully, is planned. Data col-

lection describing long-term stay patients in academic and community hospital ICUs (a prospective cohort study), including survival and post-discharge quality of life, has been completed. Initial analysis shows that many of these patients have single system failure (including respiratory), indicating that care plans or specialized treatment approaches may be appropriate for these groups of patients. At the same time, quality of life is poor for many of these patients (Martin *et al.* 1999) and this information may help guide the decision-making of patients and health care providers. All these projects are following the steps outlined earlier and their progress is set out in Table 2.

Discussion

Research networks provide a potential means of improving patient care (Keenan & Martin 1998). CCR-Net was created with the primary objective of improving the care of the critically ill patient and we believe it is having a positive impact on participating members. Indirect evidence of the validity of CCR-Net's approach to evaluating and improving patient care are provided by the literature in the form of both studies of networks using a similar methodology as CCR-Net and studies individually assessing each step of the seven-step approach. While indirect evidence is encouraging, it is not sufficient in itself. Direct evaluation is required and has already been conducted in the area of nutrition through the implementation and evaluation of a clinical practice guideline. Similar evaluation is underway or planned in other areas of critical care in the future. In addition, the ongoing success of any network depends

Table 2 Progress of CCR-Net's Projects

	<i>Nutrition in the ICU</i>	<i>Withdrawal of life support</i>	<i>Mechanical ventilation</i>	<i>Emergency admissions</i>	<i>Long stay patients</i>
Step 1 Informal needs assessment	✓	✓	✓	✓	✓
Step 2 Community-based research	✓	✓	✓	✓	✓
Step 3 Feedback to community	✓	✓	✓	✓	✓
Step 4 Identifying need for improvement	✓	✓			
Step 5 Developing clinical practice guidelines	✓				
Step 6 Implementing clinical practice guidelines	✓				
Step 7 Evaluation of clinical practice guidelines	✓				

upon member satisfaction and direct measurement of this is planned in the form of a survey. In addition to an understanding of the current satisfaction of Network members, these surveys will also elicit specific suggestions for further improvement: other care processes to evaluate, preferred frequency and methods for feedback and other concerns with current Network activities. To be ultimately successful will require ongoing re-evaluation both of all established processes of care, to adjust for new evidence or technology, and the current methodology used by the Network, to incorporate new methods of evaluating and improving patient care.

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