The Journal of Emergency Medicine, Vol. 30, No. 1, pp. 21–28, 2006

0736-4679/06 $–see front matter

ELSEVIER

doi:10.1016/j.jemermed.2005.04.014

Original Contributions

COMMUNICATION TECHNOLOGY IN TRAUMA CENTERS: A NATIONAL SURVEY

Yan Xiao, PhD,* Young-Ju Kim, PhD-C, MSN, RN,** Sharyn D. Gardner, PhD,† Samer Faraj, PhD,‡ and Colin F. MacKenzie, MBChB, FRCA, FCCM§

*Program in Trauma, School of Medicine, **School of Nursing, §National Study Center for Trauma and Emergency Medical Systems, University of Maryland, Baltimore, Maryland, †California State University Sacramento, College of Business Administration, Sacramento, California, and ‡Department of Decision and Information Technology, Robert H. Smith School of Business, University of Maryland, College Park, Maryland

Reprint Address: Yan Xiao, PhD, University of Maryland School of Medicine, 685 W. Baltimore St., MSTF 534, Baltimore, MD 21201

□ **Abstract—The relationship between information and communication technology (ICT) and trauma work coordination has long been recognized. The purpose of the study was to investigate the type and frequency of use of various ICTs to activate and organize trauma teams in level I/II trauma centers. In a cross-sectional survey, questionnaires were mailed to trauma directors and clinicians in 457 trauma centers in the United States. Responses were received from 254 directors and 767 clinicians. Communication with pre-hospital care providers was conducted predominantly via shortwave radio (67.3%). The primary communication methods used to reach trauma surgeons were manual (56.7%) and computerized group page (36.6%). Computerized group page (53.7%) and regular telephone (49.8%) were cited as the most advantageous devices; e-mail (52.3%) and dry erase whiteboard (52.1%) were selected as the least advantageous. Attending surgeons preferred less overhead paging and more cellular phone communication than did emergency medicine physicians and nurses. Cellular phones have become an important part of hospital–field communication. In high-volume trauma centers, there is a need for more accurate methods of communicating with field personnel and among hospital care providers.** © 2006 Elsevier Inc.

□ **Keywords—Communication technology; Trauma center; Team activation; Field communication**

INTRODUCTION

In a trauma center, preparation for patient arrival and activation of trauma teams in response to the expected arrival of injured patients are heavily reliant on information and communication technology (ICT). Key data about a patient during transport include estimated time of arrival, description of the patient's condition, and mechanism of injury. The timely acquisition of these data is critical for preparation and efficient use of resources at the receiving trauma center. Dissemination of timely and accurate information between pre-hospital care providers and the trauma team is needed for the mobilization of appropriate trauma team members to ensure effective care. Telecommunication technology has played an important role in transmitting pre-hospital information for decades (1). Today, hospitals are testing and implementing a variety of new ICT, such as global positioning systems and image telemetry, to improve information flow and enhance coordination of resources (2–5). Similarly, advances in communication within the hospital will help clinicians to manage interruptions and improve team coordination (6,7).

Data on current status of ICT implementations may assist design and deployment of new ICT. This article reports the results of a cross-sectional survey of ICT in

RECEIVED: 29 September 2004; FINAL SUBMISSION RECEIVED: 18 February 2005;
ACCEPTED: 6 April 2005

major trauma centers in the United States. We focused on the use of ICT in activating and organizing trauma teams, and clinicians' assessment of several core ICT devices. Additionally, we assessed pre-hospital patient information, including updates available to trauma teams before patient arrival, accuracy of communications received, and then compared usage patterns between high- and low-volume trauma centers.

MATERIALS AND METHODS

Data Collection

We visited 14 trauma centers to develop a deeper understanding of the information technologies used in trauma care. During each visit (lasting 1 or 2 days), the facilities in trauma centers were visited and patient admissions were observed for 1 to 3 h. Finally, interviews were conducted with trauma directors, coordinators, and clinicians. Based on the interviews, observations, and information gathered from documentations provided, we developed two surveys—one for trauma directors and one for trauma clinicians.

The *trauma director survey* was designed to collect information about communication methods with pre-hospital care providers and among trauma team members. The survey collected patient information available to the trauma team and identified related activities that take place before a patient's arrival and communication devices used in the trauma center. Their responses were gathered in a "yes/no" format, with an area in which respondents could list devices not among the 10 mentioned in the survey. The survey also asked trauma directors to assess the accuracy of estimated time of patient arrival within 5 min, the accuracy of information received from field care providers, and the adequacy of information disseminated to trauma team members. These items were measured by a Likert scale ranging from 1 (not at all) to 5 (to a great extent).

The *trauma clinician survey* targeted trauma staff directly involved in trauma patient care: emergency physicians (EPs), anesthesiologists, surgeons, residents, nurses, technicians, paramedics, dieticians, pharmacists, and medical students. The trauma clinicians were asked to select three of the most beneficial and three of the least beneficial communication devices used to coordinate trauma care from among 10 listed devices. A fill-in area was provided for devices not mentioned in the survey.

A list of all level I and II trauma centers in the United States was compiled by first searching the health department and emergency medical services (EMS) web pages published by all 50 states and the District of Columbia. Where possible, we relied on those web pages for indication of trauma center level designation according to the American College of Surgeons (ACS). When the ACS designation could not be determined in this way, individual state EMS directors or state trauma system directors were contacted to obtain designation methods (ACS, state, or self). A total of 457 trauma centers (207 level I and 250 level II) were identified. After the list was developed, every trauma center in the sample was contacted directly to verify status and contact information.

The survey packages were mailed to 457 level I and level II trauma centers in May 2003. A random 4-digit number generated by a third party uninvolved in the research was assigned to each trauma center to blind respondent identity. The trauma clinician surveys were sent to the trauma coordinator of each center who was asked to hand out one to each of the clinical positions described above. A self-addressed and prepaid reply envelope was attached to each survey, and participants were instructed to return the survey directly to the research team to ensure confidentiality. Five weeks after the first mailing, a second mailing was sent out to non-respondents.

Analysis Approach

In addition to descriptive statistics, we compared ICT use by six geographic regions (northwest, north central, northeast, southwest, south central, and southeast) and four levels of trauma admission volume: low (< 500), moderate (500–1000), high (1001–2000), and highest ($>$ 2000). The accuracy of communication was analyzed based on trauma admission volume and use of ICT. The usefulness of ICT as perceived by clinicians was analyzed by clinical roles. Student's *t*-test, chi-squared test, and analysis of variance were used to determine statistical significance.

RESULTS

Of the 457 identified level I and II trauma centers, seven centers stated they were no longer trauma centers and therefore were dropped from our study. Of the remaining 450 centers, we received responses from 300, giving us a 66.7% center-level response rate. The response rate of trauma directors was 56.4% (254/450), and the response rate of trauma clinicians was 46% (207/450, from 767 clinicians). Table 1 presents the numbers of level I and II trauma centers identified for the study and the response rate by state. The responses in this study represented all states of the country with the exception of Alabama, Arkansas, Hawaii, Idaho, Kentucky, and Vermont. To assess potential response bias, the number of trauma