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Original Contributions

COMMUNICATION TECHNOLOGY IN TRAUMA CENTERS: A NATIONAL SURVEY

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□ **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

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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

Table 1. Number of Level I and II Trauma Centers and Response Rate by State

State	No. of trauma centers	No. of trauma centers including responses of trauma directors (%)	No. of trauma centers including responses of trauma clinicians (%)*
Alabama	1	0 (0)	0 (0)
Alaska	1	1 (100)	1 (100)
Arizona	8	5 (63)	3 (38)
Arkansas	0	N/A	N/A
California	41	22 (54)	14 (34)
Colorado	11	4 (36)	7 (64)
Connecticut	9	5 (56)	6 (67)
Delaware	2	2 (100)	1 (50)
District of Columbia	3	1 (33)	1 (33)
Florida	18	11 (61)	4 (22)
Georgia	9	7 (78)	5 (56)
Hawaii	1	0 (0)	0 (0)
Idaho	0	N/A	N/A
Illinois	54	26 (48)	19 (35)
Indiana	5	3 (60)	3 (60)
Iowa	11	6 (55)	6 (55)
Kansas	4	0 (0)	2 (50)
Kentucky	0	N/A	N/A
Louisiana	2	1 (50)	1 (50)
Maine	3	1 (33)	2 (67)
Maryland	6	4 (67)	4 (67)
Massachusetts	5	3 (60)	2 (40)
Michigan	13	7 (54)	6 (46)
Minnesota	7	4 (57)	2 (29)
Mississippi	6	4 (67)	4 (67)
Missouri	18	10 (56)	10 (56)
Montana	3	1 (33)	2 (67)
Nebraska	5	2 (40)	0 (0)
Nevada	2	2 (100)	2 (100)
New Hampshire	5	2 (40)	1 (20)
New Jersey	10	8 (80)	4 (40)
New Mexico	1	1 (100)	1 (100)
New York	44	21 (48)	15 (34)
North Carolina	8	6 (75)	5 (63)
North Dakota	6	5 (83)	2 (33)
Ohio	21	11 (52)	10 (48)
Oklahoma	3	1 (33)	1 (33)
Oregon	7	4 (57)	3 (43)
Pennsylvania	24	15 (63)	16 (67)
Rhode Island	1	1 (100)	1 (100)
South Carolina	7	6 (86)	6 (86)
South Dakota	2	2 (100)	2 (100)
Tennessee	9	4 (44)	4 (44)
Texas	19	12 (63)	9 (47)
Utah	4	3 (75)	2 (50)
Vermont	1	0 (0)	0 (0)
Virginia	6	5 (83)	4 (67)
Washington	10	7 (70)	6 (60)
West Virginia	3	1 (33)	1 (33)
Wisconsin	4	2 (50)	3 (74)
Wyoming	7	5 (71)	4 (57)
Total	450	254 (56)	207 (46)

* Based on at least one trauma clinician survey response from each trauma center.

centers in this study was compared with that in a recent national trauma center study (8). Our list of 450 trauma centers and the directory of 453 trauma centers compiled by the American Trauma Society (ATS) Trauma Information Exchange Program (8) include the same number of trauma centers in 23 states (45.1%), are different by one or two centers in 24 states (47.1%), and are different by more than three centers in only 4 states (7.8%).

The largest groups among the 767 trauma clinicians responding to the survey were nurses (n = 263), attending surgeons (n = 155), and attending emergency physicians (n = 106), together comprising 68.6% of trauma clinician survey respondents (Table 2). The responding centers reflected known trauma center distribution, with the north central (29.9%) and northeast (27.2%) regions forming the largest groups (Table 2). About half (50.7%) of the trauma centers had 1000 or more trauma admissions during the most recent fiscal year. More than 1700 patients per year on average were admitted to level I trauma centers, whereas an average of 800 patients were admitted to level II trauma centers during the most recent fiscal year. A majority (76.8%) of trauma patient admissions were direct admissions from the scene of trauma.

ICT Devices Used for Communication

The majority of field communication with pre-hospital care providers was through shortwave radio (67.3%)

Table 2. Characteristics of Respondents and Trauma Centers

Characteristics	Total (%)
Respondents*	
Trauma directors	254
Trauma clinicians	767
Attending surgeon	155 (20.3)
Attending anesthesiologist	45 (5.9)
Attending emergency physician	106 (13.9)
Nurse	263 (34.4)
Nurse practitioner	32 (4.2)
Resident	63 (8.2)
Technician	44 (5.8)
Other	59 (7.7)
Region**	
Northwest	18 (7.1)
Southwest	37 (14.6)
North central	76 (29.9)
South central	18 (7.1)
Northeast	69 (27.2)
Southeast	36 (14.2)
Number of trauma admissions in the past year**	
< 500	31 (19.1)
500–1000	49 (30.2)
1001–2000	57 (35.2)
> 2000	25 (15.4)

* Number of individual respondents.
** Number of trauma centers.

Table 3. Use of Information Technology for Communication† (n = 254, %)

	Computerized page*	Manual page**	Shortwave radio	Regular telephone	Cellular phone	Overhead page	Cordless house phone	Electronic signage	Dry erase whiteboard	E-mail
Field communication with pre-hospital care providers	5.5	2.0	67.3	32.3	32.7	2.4	10.6	0	0.8	1.6
Alerting the trauma team of an incoming patient	76.4	22.0	3.1	16.9	7.1	33.9	5.5	0.8	1.2	0
Notification to the trauma team for a trauma consult	18.5	62.2	1.2	29.1	7.1	9.4	7.1	0.8	0.8	0
Notification of an impending surgery to operating room staff	34.3	19.3	1.2	70.1	5.5	9.4	7.5	0.8	0.4	0
Methods to reach the trauma surgeon	36.6	56.7	1.2	39.4	11.4	9.1	3.1	1.6	0.4	0.4

* All team members paged at once.
** Individual members paged one at a time.
† Respondents were asked to check all IT devices being used in their trauma centers.

(Table 3). Cell (including satellite) phone (32.7%) and regular telephone (32.3%) were the next most frequently used devices for this communication. The majority of trauma centers (76.4%) alerted their trauma team members of an incoming patient using a computerized group page. By contrast, the regular telephone (70.1%) was used predominantly to notify the operating room staff of an impending surgery. The most often used communication methods to reach the trauma surgeon were manual page (56.7%), regular telephone (39.4%), and computerized group page (36.6%).

Table 4 compares most frequently used ICT devices by admission volume. The low-volume trauma centers with fewer than 500 trauma admissions annually used cell phones significantly more frequently than other trauma centers to communicate with pre-hospital care providers ($p < 0.03$). The low volume trauma centers employed the computerized group page to alert the trauma team significantly less than higher volume trauma centers (54.8% vs. 83%, respectively, $p < 0.01$) and to reach the trauma surgeon (19.4% vs. 41.6%, respectively, $p < 0.04$). No differences were found in terms of use of a shortwave radio for communication with pre-hospital care providers among the six regional groups ($p = 0.38$). However, the use of cell phones was significantly higher in the north central and northwest regions than in other regions ($p < 0.05$).

Information and Activities Available to Trauma Team Before Patient Arrival

Age, gender, vital signs, and mechanism of injury were patient information mostly available to the trauma team before patient arrival at the hospital (Table 5). Triage level and treatment performed at site or during transport

Table 4. Most Frequently Used IT Devices for Communication by Trauma Admission Volume† (%)

	Field communication with pre-hospital care providers		Alerting the trauma team of an incoming trauma patient		Notification to the trauma team for a trauma consult		Notification of an impending surgery to operating room staff		Methods to reach the trauma surgeon	
No. of trauma admissions	Radio	Cell phone*	Computerized page*	Manual page*	Manual page	Regular phone*	Regular phone	Computerized page	Computerized page*	Manual page
< 500	64.5	51.6	54.8	45.2	45.2	51.6	71.0	22.6	19.4	61.3
500–1000	63.3	30.6	83.7	18.4	73.5	34.7	67.3	40.8	30.6	69.4
1001–2000	68.4	29.8	77.2	24.6	56.1	8.8	66.7	36.8	42.1	54.4
> 2000	68.0	24.0	88.0	8.0	64.0	12.0	68.0	32.0	52.0	44.0

* $p < 0.05$.
† Respondents were asked to check all IT devices being used in their trauma centers.

Table 5. Before Patient Arrival, Patient Information Available to Trauma Team

Information	n (%)
Mechanism of injury	236 (92.9)
Sex	223 (87.8)
Age	206 (81.1)
Vital signs	204 (80.3)
Level of consciousness	198 (78.0)
Airway status	197 (77.6)
Intravenous access	170 (66.9)
Treatments performed	162 (63.8)
Triage level	142 (55.9)

were available at, respectively, 55.9% and 63.8% of responding trauma centers.

Over half of the responding trauma centers reported that trauma teams were able to receive updates of patient vital signs during patient transport. The activities using other ICTs, such as viewing of the patient on scene and faxing of any patient information from pre-hospital care providers, were not frequently available (Table 6).

Accuracy of Communication

The respondents perceived that field care providers provided more accurate estimated time of patient arrival and more accurate reports on mechanisms of injury in low volume trauma centers than occurred at higher volume centers ($p < 0.01$). Although the extent of injuries reported by pre-hospital personnel was thought to be more accurate in low-volume trauma centers, it was not statistically significantly different than in higher volume centers (Table 7). The information from field care providers was widely disseminated in trauma centers with low admission volume, but the difference compared with higher volume centers was not significant.

Use of a cell phone was associated with more accurate information regarding the estimated time of patient arrival and mechanism of injuries compared with use of ICT devices other than cellular phone ($p < 0.05$) (Table 8).

Most and Least Beneficial Communication Devices

Half of the responding trauma clinicians indicated that a computerized group page (53.7%) and regular telephone (49.8%) were the most beneficial ICT devices for coordination of trauma care (Table 9). In comparison, e-mail (52.3%) and dry erase whiteboard (52.1%) were selected as the least beneficial devices.

The respondents were ambivalent about the value of the overhead page: 32.6% of clinicians ranked it as beneficial whereas 36% ranked it as least beneficial. Further analysis of this finding showed that specialty differences existed (Figure 1). As a group, attending surgeons found the overhead page to be least beneficial compared with other clinicians ($p < 0.00$). In addition, significantly more attending surgeons (56.1%) preferred a cellular phone for coordination than did anesthesiologists (40.0%), EPs (31.1%), and nurses (30.2%).

DISCUSSION

Devices Used for Communication

This study found that radio was the most frequently used method of communication with the field. The use of a statewide EMS radio system for direct field communication was present in 40% of the 35 states that participated in the EMS technical assessment program in 1993 (9). Although the comparison of use of the radio system was not available at the state level, it has become more common, as shown in this study that 67% of trauma centers in 45 states use a radio system. Despite the increasing popularity of cellular phones among consumers, our study showed that only 33% of the trauma centers used a cellular phone as a field communication method. The cellular phone communications are a valuable supplement to radio communication when channels are overcrowded or communications are needed in coverage of dead spots (10,11). Yamamoto compared features of radio systems and cellular phones (12). The cellular phone has more clarity, hands-free operation, multiple simultaneous transmissions, easier procedure to initiate communication, and lower cost of equipment/maintenance. However, although cellular services may be effective under many circumstances, cellular bandwidth can be easily overwhelmed in the event of mass casualty incidents or catastrophes (10). For example, a level I trauma center in New York City experienced intermittent interruptions of telephone and cellular communication after the 2001 World Trade Center attack (11). In downtime when cellular phones are over-

Table 6. During Patient Transport, Activities Available to Trauma Team

Activities	n (%)
Get updates of patient vital signs	150 (59.1)
Speak to field care providers at any time	96 (37.8)
Get single data points of vital signs by voice or electronic means	79 (31.1)
Obtain FAX from field care providers during transport	2 (0.8)
See images of patient/scene	1 (0.4)

Table 7. Perceived Accuracy of Communication by Trauma Admission Volume, Mean (SD)†

No. of trauma admission	Accuracy of estimated time of patient arrival within 5 min*	Accuracy of information regarding mechanism of injuries from field*	Accuracy of information regarding extent of injuries from field	Adequate dissemination of information about an incoming patient to trauma team
< 500	4.27 (0.74)	4.20 (0.71)	3.50 (0.82)	3.67 (0.84)
500–1000	3.67 (0.99)	3.76 (0.66)	3.43 (0.74)	3.43 (0.96)
1001–2000	3.45 (1.01)	3.44 (0.99)	3.12 (0.79)	3.30 (0.98)
> 2000	3.59 (1.04)	3.76 (0.66)	3.29 (0.79)	3.00 (1.19)

* $p < 0.05$.
† Score range: 1 (not at all) to 5 (to a great extent).

whelmed, land lines are most available. However, availability of key personnel and time to make connection are limiting factors. Hand-held shortwave radios are the alternative of choice to cell phones.

The association between the use of cellular communications with the provision of more accurate information is interesting. This study found that low-volume trauma centers (< 500 admissions) relied as much on cellular phones as on shortwave radios. We speculate several reasons why cellular phone usage was associated with more accurate information. First, cellular phones allow duplex communication. Two parties can speak at the same time, allowing one party to interrupt the other (12). Second, the voice quality may be better and reduce the need for repeating information (13). Lastly, duplex communication using cellular phones reduces the chance of cutting the first few syllables of transmission, as may happen with simplex, radio systems (14). Accurate and timely information communication through reliable devices would reduce preparation time for a facility to be ready to care for the incoming patients (15). Also, it would decrease unnecessary transfers between hospitals by immediately informing EMS crews about bed availability and diversion status (16).

The vast majority (76%) of trauma centers in our study used a computerized group pager to alert the trauma team. Activation of the trauma team is a time-sensitive but straightforward activity with recognized criteria for calling the team and requesting the presence of specialists (17). Consistent with our findings, an Australian national survey of trauma teams found that 61% of trauma teams are activated simultaneously by their hospital switchboard, and the remaining trauma teams are contacted individually (17). In the current study, highest volume trauma centers relied heavily on computerized paging to activate the trauma teams. Contacting each trauma team member individually will clearly be slower than a group contact mechanism (18).

The survey results show that wireless, in-house two-way communication was not used widely. Two-way communication systems can improve coordination. Gerndt and colleagues showed that utilization of a two-way radio system for in-hospital trauma communication, along with implementation of a pre-hospital trauma classification system, was efficient in shortening initial time to complete evaluation of the trauma patient and reduced costs of emergency care for these patients (4).

Information and Activities Available before Patient Arrival

Accurate patient information, before patient arrival at the hospital, allows the trauma team to prepare to receive patients and to allocate space, staff, and equipment (19). In our study, demographic data such as age and gender, and clinical information like vital signs, injury mechanism, and airway status were commonly given to the

Table 8. Perceived Accuracy of Communication by Use of IT Devices, Mean (SD)†

	Accuracy of estimated time of patient arrival within 5 min		Accuracy of information regarding mechanism of injuries from field		Accuracy of information regarding extent of injuries from field	
Use of IT devices	Radio	Cell phone*	Radio	Cell phone*	Radio	Cell phone
No use	3.56 (1.04)	3.44 (1.11)	3.81 (0.84)	3.64 (1.11)	3.35 (0.87)	3.27 (0.87)
Use	3.58 (1.09)	3.86 (0.94)	3.72 (0.88)	3.97 (0.90)	3.31 (0.89)	3.42 (0.91)

* $p < 0.05$.
† Score range: 1 (not at all) to 5 (to a great extent).

Table 9. Most and Least Beneficial Communication Devices for Coordination of Trauma Care (n = 767)

Rank	Most beneficial IT (%)	Least beneficial IT (%)
1	Computerized group page (53.7)	E-mail (52.3)
2	Regular telephone (49.8)	Dry erase whiteboard (52.1)
3	Cell or Satellite phone (36.0)	Overhead page (36.0)
4	Overhead page (32.6)	Electronic signage (34.5)
5	Manual group page (26.5)	Radio (21.8)

trauma team before patient arrival. In contrast, information regarding triage level, treatment performed, and intravenous access was not commonly available. Whether such information is useful for the trauma team may depend on individual trauma center practices.

This study revealed that little usage of advanced information and communication technology was reported between pre-hospital care providers and receiving trauma team. For example, it has become increasingly possible to transmit images on videos directly from the field to trauma centers (20). Vital signs and other clinical findings may be digitally transmitted, reducing the need for voice communication (21). Advanced information communication technology via two-way voice, video, and data transmission may reduce the communication workload and interruptions, and improve dissemination of key information and ultimately quality of patient care. The relative cost of each device varies from lowest to highest for plain telephones, cell phones, simple shortwave radios, etc. The complexity, cost reliability, robustness for field use, and the added values of images in each ICT device remain to be justified by testing in multiple jurisdictions.

Clinicians' Perception of Communication IT Devices

Asynchronous communication devices, where two individuals do not attend in a conversation at the same time, such as e-mail and dry erase boards, were not widely used, although they are less interruptive. An explanation may be that for busy, multi-tasking clinicians, communication devices must provide some confirmation that the communication occurred. As Coiera and Tombs noted in their study of communication behaviors in a hospital, most care providers seemed to prefer an immediate acknowledgement of the receipt of a message (22). This acknowledgment in many hospitals is mainly possible with synchronous channels such as face to face or telephone but not with the available asynchronous channels such as e-mail or whiteboard (22).

We found it interesting that significantly fewer attending surgeons preferred overhead paging than did EPs or nurses. An explanation could be that emergency physicians and nurses are mostly physically located in the trauma unit or emergency department (ED), but attending surgeons usually are not. Clinicians in the trauma unit or ED may use overhead paging as the first communication method for requiring the quick presence of a surgeon. Otherwise, they may use it as a supplementary method of contact after paging a surgeon individually and waiting for a response. Surgeons indicated that they preferred cellular phone communication. They can ignore pagers when they are overwhelmed by the sheer volume of communication, and they might not want to have their overhead page broadcast through the hospital.

The survey findings reported here provide an inventory of ICT used for communication and coordination in trauma care. Clearly, variations in technology may be related to earlier design choices, the culture of a hospital, type and level of care provided, the overall communication load placed on individual care providers, state regulations, and budgetary considerations (6,16). The efficient use of ICT devices may reduce the communication loads on clinical staff and the time involved in communication. These reductions may subsequently affect the processes and outcomes of patient care. Further study is needed to examine the impact of the use of ICT devices for communication on clinical outcomes.

The current study was unable to identify issues encountered when each communication device was used in a clinical setting or the back-up system. Also, whether communication technologies had an impact on trauma patient outcomes could not be assessed, as outcomes from each trauma center were confidential and not accessible for review. Further studies are needed to investigate cost-effective communication devices and their impacts on patient care and outcomes.

Another study limitation is that the findings were

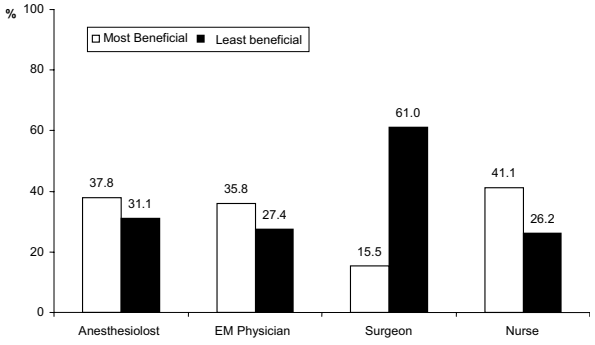

Figure 1. Perceived usefulness of overhead page.

derived from the perception of trauma directors and clinicians, not from objective measurement. There may be a gap between perception of trauma directors and actual use of ICT devices. However, the cross-sectional survey methodology used in this study allowed us to reach as many trauma centers as possible and to provide a detailed inventory of their ICT usage.

In summary, cellular phones were used by 25% to 50% of trauma centers, and seemed to be an important part of hospital–field communication. Wireless two-way voice communications were associated with improved communication accuracy. Computerized group paging was the dominant mode of trauma activation methods, perhaps due to its simplicity and reliability. For high-volume trauma centers, there was a general consensus of needing methods to improve accuracy of communication with the field and among hospital care providers.

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