A Concept Worth Stealing

Portland's On-Line Hospital EMS Information System

It has been said consultants are best judged by the quality of the ideas they steal from others, and the speed with which they manage to associate their own names in print with the stolen concepts. In that spirit, I proudly announce that I have already stolen and applied in my own work one of the best new concepts in EMS today: the on-line hospital information system developed and implemented by the authors of this month's guest "Interface" article.

When I first heard about Portland's on-line hospital information system, I incorporated the concept into the design of Pinellas County, Florida's state-of-the-art EMS operations control center and medical communications system. Thanks to EMS folks in the Portland area, patients of Pinellas County's EMS system will reap the benefits of a better idea. Perhaps yours can benefit, too.

Although the system described below was originally developed for trauma information, the concept can easily be expanded to handle the full range of facility information required for fast and accurate EMS management on a day-to-day basis. Furthermore, the advantages of such a system in a medical disaster are profound and obvious. The system provides real-time information, conveniently displayed at every participating hospital and at the EMS control center, on the current status of staff capability and various support services at every participating facility!

The concept is flexible. Whereas Portland uses a single designated "medical resource hospital" for on-line medical control, Pinellas County employs a managed but decentralized on-line control system. (See "Interface," March 1988 *JEMS*.) In Pinellas County, the information system will actually facilitate decentralized control by showing the current availability of certified base station physicians throughout the hospital system. And while Portland uses a simple but effective automated telephone polling method to update information, Pinellas County's application piggybacks the county-wide microwave system to accomplish the same purpose.

While some form of hospital categorization and trauma center designation, combined with clearly-defined prehospital transport protocols, is essential to error-free selection of hospital destination, the truth is that actual capabilities of individual facilities can and do change on a moment-to-moment basis. Portland's automated on-line hospital information system furnishes the missing link between *planned* capabilities, and the reality of the moment when decisions must be made. — *J. Stout*

Computerized Trauma Communications System

by Keith Neely, BA, John Moorhead, MD, William Long, III, MD, Ronald Potts, MD, Joe Acker, MPH, and John Schriver, MD

Previous attempts to develop a community trauma plan among the hospitals of the Portland, Ore. area had historically failed. Obstructing this effort were the pitfalls surrounding hospital trauma center designation, particularly the lack of a designating authority. A study demonstrated that local trauma care was fragmented and that preventable deaths were occurring.

In February 1985, a voluntary community trauma plan was implemented, following a community-wide planning process. The plan addressed: 1) triage criteria for admission and discharge of patients; 2) hospital facilities and personnel criteria, closely adhering to the American College of Surgeons' Level I recommendations; and 3) system communications including the development of an unique inter-hospital telecommunications system. The plan allows any hospital to participate and, as long as established standards are met, to receive trauma patients. The timing of individual hospital availability is left entirely to individual institutions.

The linchpin of this plan is a computerized interhospital telecommunications system with video display, based at the emergency medical communication facility of a previously designated medical resource hospital (MRH), which provides on-line medical control for the Portland area. Each participating hospital has a terminal located in the emergency department and is connected to the MRH by telephone land line. This terminal displays the availability of trauma care for every hospital in the plan. Personnel of the participating hospitals are responsible for accurately updating their own information. As Figure 1 shows, the availability of each hospital is displayed using green, yellow and red coding; it includes the specific status of nine hospital facilities as well as personnel criteria (such as, the availability of a trauma surgeon, CAT scanner, operating room, etc.).

The system computes and displays individual hospital availability as open (green) or closed (red), or open on a limited basis (yellow). No outside personnel (including the MRH) can alter another hospital's information. Paramedics in the field, after estimating the severity of injury, are required to contact the MRH by radio or telephone. This facility has dedicated emergency communications personnel to interpret and provide information, and utilizes the MRH emergency department physicians, if consultation is needed. The paramedic selects the most appropriate hospital by applying pre-established criteria to the information provided. Emergency communications

personnel immediately notify the receiving hospital and record pertinent information. All voice communications and hospital status changes are automatically recorded and are available for review.

At implementation, 14 area hospitals agreed to participate in the communications system. By not participating, hospital personnel recognized that seriously injured patients would not be transported to their facility, but retained the privilege of joining later. It soon became evident that only four of the 14 hospitals met the standards to receive trauma patients frequently. Meeting the standards required considerable staff commitment and some additional expense.

The remaining hospitals usually observed the system or were occasionally available. As the first year progressed, one originally active hospital reduced its availability while two additional hospitals increased their availability. Thus, five hospitals became active, each serving a geographically distinct catchment area.

By December 1, 1987, 7,400 patients had been admitted into hospitals by the system. While the plan was being devised by the Multnomah County EMS community, the adjoining counties either adopted a similar plan of their own or chose to operate under the Multnomah County plan. Currently, MRH regularly interacts with more than 20 EMS agencies in seven counties, including Clark County in Washington State which is directly across the Columbia River from Portland.

More than 90 percent of the patients are taken to one of the five hospitals (see Figure 2). The remaining patients either refuse transport, are discharged from the trauma system and are lost to data collections, or are taken to other hospitals. Two factors — availability and geographic location — appear to correlate with the number of trauma patients transported to a given hospital. A monthly statistical report is updated and distributed by MRH. This information replaces anecdote and rumor, and provides the basis for quality assurance review, continuing education, research and system revision.

Operational Characteristics

A number of operating characteristics of the telecommunication system has become apparent. None in themselves are unique, but as a whole, represent an advance in interhospital communications. Commonly, only community disaster preparedness plans have required that hospitals be linked together, usually by radio.

Comprehensiveness. The system is designed to require a response for nine hospital facilities and personnel criteria is identified for the management of the severely injured (see Table 1). The status of the personnel determines the availability of the hospital. (Thus, multiple personnel within a hospital contribute to this determination.) This design serves as a constant reminder of the required standards and emphasizes the team approach to trauma care. Those hospitals with improved intrahospital communications are required to participate and the standards which are consistently difficult to meet are readily identified.

Figure 1: *A typical display of the color-coded status of nine of the 14 facilities.*

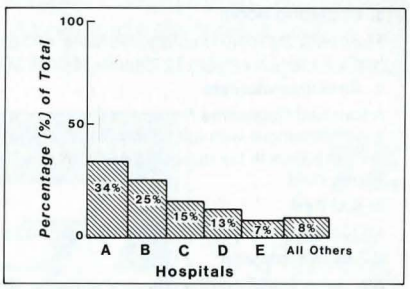

Figure 2: *The relative distribution of trauma patients to the five actively participating hospitals (total patients 7,400).*

Responsiveness and Flexibility. It is clear that the telecommunication system is being used in a manner which takes advantage of its flexibility. Hospital personnel are able to change their hospital's status promptly and easily. Going "down" because of equipment maintenance or temporary personnel unavailability is now accomplished routinely, even for short periods, with the assurance that returning to "up" status is simple and reliable. This replaces previous practices involving multiple telephone calls and dependence upon the communications and reliability of others which was so difficult that few hospitals ever went "down" for any reason. Furthermore, with hospital availability monitored by a single communications center, it is easy to coordinate patient distribution from multiple patient incidents, thus ensuring that no single hospital's capacity is temporarily overwhelmed. For example, a computerized trauma system can easily handle a situation such as when 61 incidents produced three or more patients each for a total of 202 patients.

Compliance and Accuracy. The telecommunnication system is easy to use and requires a simple orientation. Early problems with compliance were sorted out with experience. Accuracy of information displayed is probably influenced by several factors. These include the integrity of the involved health-care professional, the specificity of criteria, the wide display and publication of information, interaction with independent observers (paramedics), and the medicolegal climate. Incidents related to inaccurate information appear to be due to carelessness rather than intent. An initially unanticipated problem arises occasionally when none of the participating hospitals indicate availability. In this case, MRH communications personnel attempt to "recruit" a hospital, a task considered simplified by the comprehensive information displayed indicating the specific reasons a given hospital is not available.

Reliability. Early experience with the telecommunication system has shown that it is technically very reliable and only a few changes have been required after nearly three years of use. The system has occasionally failed for short periods during which time an erasable board was used to record hospital status and updated by telephone call. Some continuing technical problems relate

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to the interface between telephone systems in adjoining counties.

Cost Effectiveness. The initial cost of the communication system for each participating hospital was $2,400. Simple game-format computer terminals are adequate. Original system programming costs were $4,000. Dedicated telephone land lines utilized to interconnect hospitals cost participating hospitals about $60 per month. Medical Resource Hospital communications personnel were funded from existing funds originally allocated for emergency department admitting clerk positions; however, the personnel performed other communication tasks as well. The prehospital care "medical control" radio/telephone communication system had been previously established. Additional costs, which are more difficult to calculate, are a result of many hospitals' attempts to become "trauma centers." However, they are costs of the plan, not the telecommunication system.

Limitations of the System

The immediate acceptance and use of the voluntary hospital trauma plan was thought to be largely due to its careful and flexible planning and the design of the telecommunications system, which meet an informational need. A technical limitation has been the potential delay of up to seven minutes in the automatic updating of information at the MRH because of a call voting procedure over telephone land lines. This delay has occasionally been a problem. Television cable hospital intercommunications would provide instantaneous change but are not yet available locally. Chief limitations are not of the telecommunications system but of the plan, itself, which did not call for designation of trauma hospitals. Thus, from its inception, the plan has been regarded as an interim one, to be succeeded by a state-directed hospital designation process. This designation occurred in October, 1987, and has identified two hospitals to continue as trauma centers after March 1, 1988, and to serve six counties. Experience with the present plan has been and will be of value in the evolution of that process. The first of many operating agreements required of the two designated centers was on patient distribution. This was made

Table 1: Facilities Criteria

The Facilities Criteria subcommittee recommended adoption of a minimum standard of American College of Surgeons Level II for participants in the trauma system, and further recommended that the system be dynamic: that is, facilities would be able to participate any time they had the requisite resources. The trauma committee selected those resources it felt were essential to the optimum care of the trauma victim for inclusion in the plan. The following are the minimum requirements that facilities must meet in order to receive victims of serious trauma:

Status Green — At this moment the hospital meets all criteria to receive any victim of serious trauma

Status Yellow — At this moment the hospital meets some but not all of the essential criteria:
- CT Scanner and/or Neurosurgeon unavailable
- ***or*** Surgeon available within 15 minutes' notification

Status Red — At this moment the hospital is unavailable to receive trauma victims

Available upon patient arrival in the ED — Assumes at least five minutes advance notification of the trauma receiving hospital by the Medical Resource Hospital Communication Center

ATLS/ACLS Certified — Within 12 months of adoption of this plan

STANDARDS

1. Emergency Department

A fully equipped trauma resuscitation area is available on patient arrival in the emergency department. A board-certified emergency physician or a physician in the full-time practice of emergency medicine (preferably qualified to sit for the American Board of Emergency Medicine); ATLS certified, ACLS certified, is available in the emergency department. A minimum of two emergency department registered nurses with skills in trauma and cardiac life support are available in the emergency department to attend the arriving trauma patient.

2. Angiography Suite

The angiography suite is operational and fully equipped for fluid resuscitation. It will be empty, available, staffed, and ready for angiography within 30 minutes of notification by the emergency department.

3. Operating Room

The operating room is empty, available, and fully equipped for trauma surgery. It will be staffed and ready for surgery within 15 minutes of notification by the emergency department.

4. Anesthesiologists

A Certified Registered Nurse Anesthetist or Anesthesiology Resident is available in the hospital. An anesthesiologist with full, unrestricted privileges, ATLS certified, ACLS certified, will be available in the hospital with the operating room team within 15 minutes of notification by the emergency department.

5. ICU Bed

An ICU bed is empty, available, and fully equipped for multisystem monitoring.

6. Trauma Surgeon

A board or FACS certified general surgeon, ATLS certified, is in the hospital and available to the patient on the patient's arrival in the emergency department.

7. Standby Trauma Surgeon (In lieu of standard VI)

A board or FACS certified general surgeon, ATLS certified, is on call by dedicated pager, and will be available to the patient in the emergency department within 15 minutes of notification from the prehospital care system that a trauma patient will be arriving.

8. Neurosurgeon

A neurosurgeon with full, unrestricted privileges, ATLS certified, and available in the hospital within 30 minutes of notification by the facility.

9. Computerized Tomography (CT)

The CT scanner is operational, located at the hospital, and fully equipped for fluid resuscitation. It will be empty, staffed, and ready for scanning within 30 minutes of notification by the emergency department.

Special Notes:

1. If a facility meets standards 1-6, 8 and 9, that facility may receive all types of trauma regardless of the patient's estimated time of arrival (ETA) in the emergency department. (Status = Green)

2. If a facility meets standards 1-6, that facility may receive all types of trauma except head trauma. (Status = Yellow)

3. If a facility meets all of the standards except standard 6, it may receive (Status = Yellow):
   - any trauma victim with an ETA of 15 minutes or greater and no Status Green hospitals closer.
   - any trauma victim regardless of ETA if it is the closest hospital when no facilities are Status Green.
   - any head trauma victim regardless of ETA if it is the closest hospital when no facilities can meet Standards 8 or 9.

4. If a facility meets all of the standards except Standard 6, 8 and 9, it may receive all trauma victims except head trauma subject to the requirements in "3" above (Status = Yellow)

5. If a facility fails to meet any one of Standards 1-5, or 6 and 7, it should defer from receiving trauma patients. (Status = Red)

6. No facility should receive more than one critically injured patient if there are other hospitals on "Green" status.

much simpler with data derived from the interim experience, which identifies specific location of traumatic incidents. From this data, maps showing proportions and distributions of trauma were developed.

Another problem with the current interim plan, common to many, is the triage criteria resulting in over-triage rates of up to 90 percent.[2,3] Heavy emphasis is given to the mechanism of injury alone in order to identify a trauma system patient. This has been identified as a major shortcoming. It has been addressed by modifying the triage criteria for the new system to make them consistent with those recommended at the recent American College of Surgeons' Committee on Trauma consensus conference in San Francisco.

Future Directions

The interhospital telecommunication system is being considered for community disaster preparedness planning and other situations where the availability of resources for acute care and cooperation between hospitals is important. Since its inception, utilization of the system has expanded to include a hospital-based helicopter service. The current MRH facility has been assigned the communication tasks of the recently designated hospital trauma system which will incorporate a modified interhospital facilities status system between the designated hospitals. This will help the trauma centers provide mutual support for each other and allow each to monitor their own capabilities.

The interhospital telecommunication system facilitated the establishment of a functioning voluntary community trauma system, previously thought inoperable to many participants. Proper and flexible planning, appropriate checks and balances, good data collection and review have replaced other methods. A spirit of cooperation is now practiced in the management of trauma patients in the Portland, Oregon metropolitan area. □

"Automated on-line hospital information systems furnish the missing link between* planned *capabilities, and the reality of the moment when decisions must be made."

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