[4] Kaski D, Kumar P, Murphy E, Warner TT. Iatrogenic B12 deficient peripheral neuropathy following nitrous oxide administration for functional tonic led spasm: a case report. Clin Neurol Neurosurg 2017;160:108–10.
[5] Li H-T, Chu C-C, Chang K-H, Liao M-F, Chang H-S, Kuo H-C, Lyu R-K. Clinical and electrocardiographic characteristics of nitrous oxide-induced neuropathy in Taiwan. Clin Neurophysiol 2016;127:3288–93.
[6] Tatum WO, Bul DD, Grant EG, Murtagh R. Pseudo-Guillain-Barre syndrome due to "Whippet"-induced myeloneuropathy. J Neuroimaging 2010;20:400–1.
[7] Rai S, Frasca J, Hewage U, Hedger S. Nitrous oxide-induced cervical myeloneuropathy involving posterior column with normal range vitamin B12. Imperial Journal of Interdisciplinary Research 2016;2:1466–70.
[8] Metz J. Cobalamin deficiency and the pathogenesis of nervous system disease. Annu Rev Nutr 1992;12:59–79.
[9] Goodman JC. Neurological complications of bariatric surgery. Curr Neurol Neurosc Rep 2015;15:1–7.
[10] Seizer RR, Rosenblatt DS, Laxova R, Hogan K. Adverse effect of nitrous oxide in a child with 5,10-methylenetetrahydrofolate reductase deficiency. N Engl J Med 2003;349:45–50.
[11] Obeid R, Hermann W. Mechanisms of homocysteine neurotoxicity in neurodegenerative diseases with special reference to dementia. FEBS Lett 2006;29:2994–3005.
[12] Savage S, Ma D. The neurotoxicity of nitrous oxide: the facts and "putative" mechanisms. Brain Sci 2014;4:73–90.
[13] De Vasconcellos K, Sneyd JR. Nitrous oxide: are we still in equipoise? A qualitative review of current controversies. Br J Anaesth 2013;111:877–85.

Novel information and communication technology system to improve surge capacity and information management in the initial hospital response to major incidents

The initial response of local hospitals to major incidents involving natural and anthropogenic hazards is crucial [1-6]. When a major incident is recognized by a hospital's headquarters, it is necessary to increase medical surge capacity and capability before external supports arrive. Thus, the hospital must communicate a variety of information to multiple staff, including those who are off-duty [1, 7]; staffing is key to increasing surge capacity [8-12].

Few investigations of emergency staffing have been conducted [13]. Hospitals have reported using an emergency telephone contact system—a so-called "phone tree"—or automatic assembly according to predetermined criteria [14]. However, phone trees necessitate direct verbal communication and the information is only communicated to one staff member at a time. In the automatic assembly method, health-care providers are required to collect the necessary information by themselves. Moreover, subsequent information management, such as personnel assignment after emergency staffing, is an essential element in the initial hospital response. Despite this, rarely have effective information management systems been developed [8, 15].

The recent development of information and communication technology (ICT) has been remarkable [16-19]. ICT could be used for emergency staffing and subsequent information management [15]. Specifically, we hypothesized that, compared with existing methods, an ICT system would enable prompter and more accurate information transfer with more effective utilization. We developed a new ICT system with three functions: (1) simultaneous notification, (2) response and arrival status management, and (3) personnel assignment and verified its effectiveness in simulation tests (Figs. 1–2 and details [Supplementary data]).

In simulation test 1 (information transmission), our ICT system transmitted information to the staff and back to headquarters significantly more rapidly than the conventional phone tree approach ($P < 0.01$; Fig. 3). The ICT system transmitted information to study participants significantly more accurately than the phone tree approach ($P < 0.05$; Fig. 4A–C).

In simulation test 2 (the information management of the personnel assignment function), all study participants successfully completed

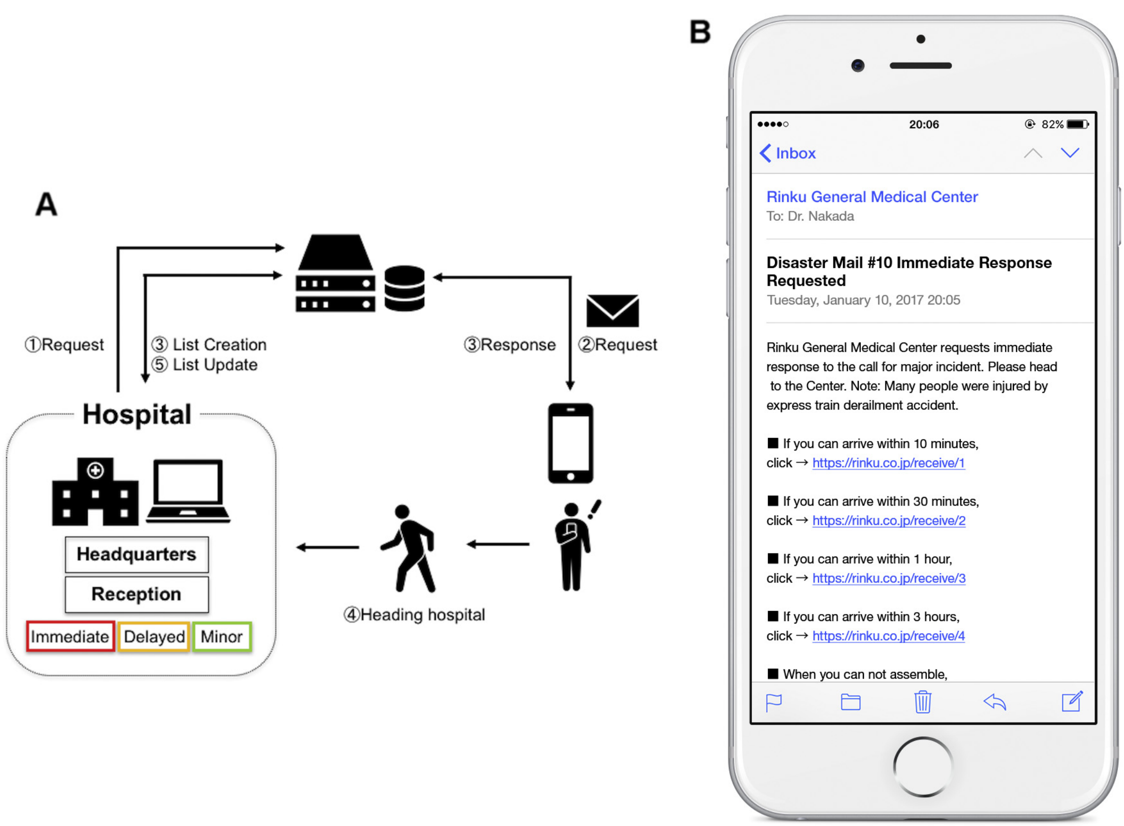
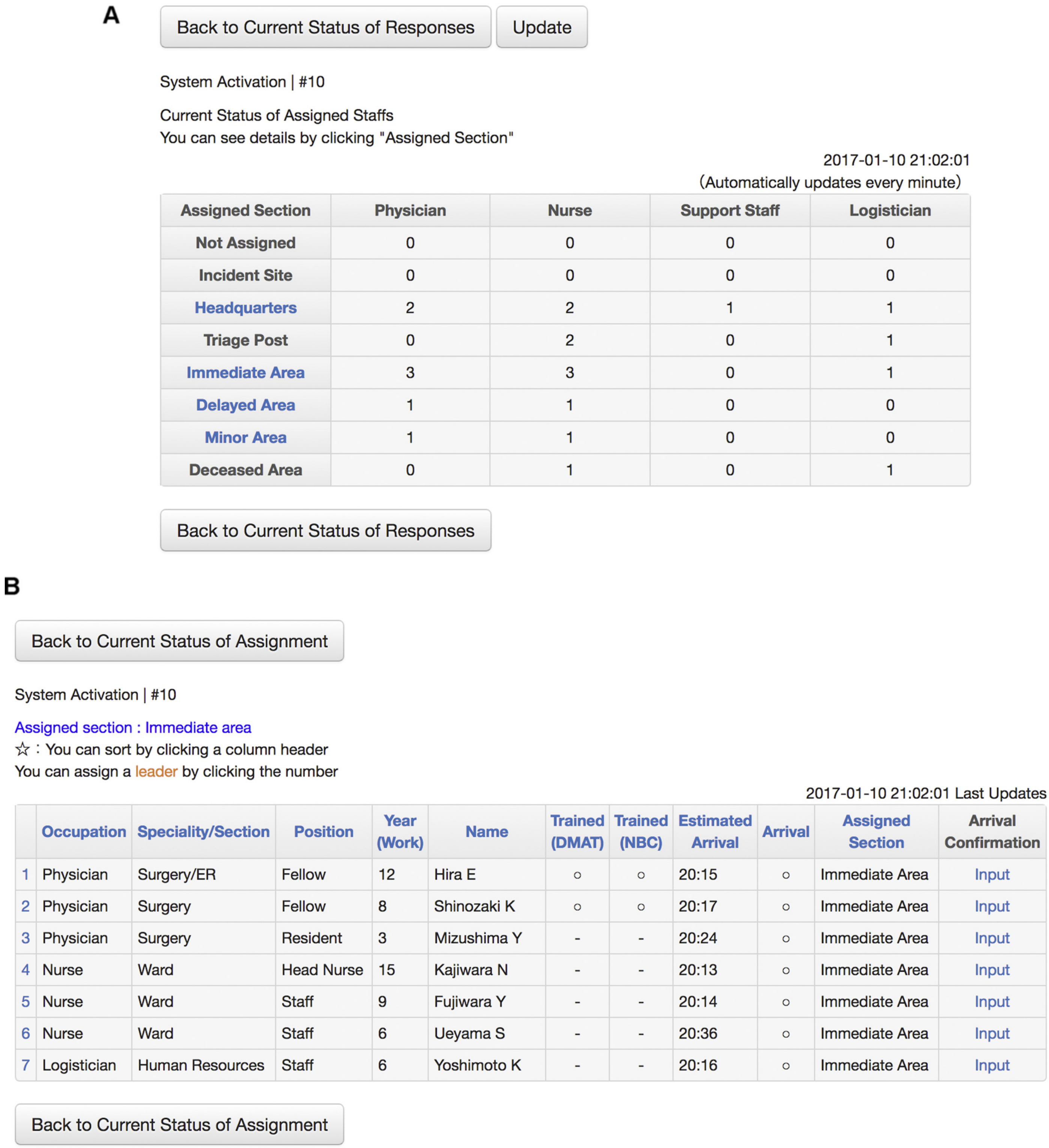


Fig. 1. Panel A: Schematic diagram of procedure. A headquarters in the hospital activates the system by filling in a request form. The request is securely transferred to a cloud server via the internet. The cloud-based software automatically creates an e-mail based on the content of the request; it then sends the e-mail to staff mobile phones. Responses from staff outside the hospital are transferred to the cloud server, where a record of current response status is created and updated at all times. After staff members arrive, the ICT system can add information regarding their assigned area to aid personnel assignment. Panel B: Received mail text in mobile phone of staff outside hospital.


A

Back to Current Status of Responses | Update

System Activation | #10

Current Status of Assigned Staffs
You can see details by clicking "Assigned Section"

2017-01-10 21:02:01
(Automatically updates every minute)

Assigned Section	Physician	Nurse	Support Staff	Logistician
Not Assigned	0	0	0	0
Incident Site	0	0	0	0
Headquarters	2	2	1	1
Triage Post	0	2	0	1
Immediate Area	3	3	0	1
Delayed Area	1	1	0	0
Minor Area	1	1	0	0
Deceased Area	0	1	0	1

Back to Current Status of Responses

B

Back to Current Status of Assignment

System Activation | #10

Assigned section : Immediate area
☆ : You can sort by clicking a column header
You can assign a leader by clicking the number

2017-01-10 21:02:01 Last Updates

	Occupation	Speciality/Section	Position	Year (Work)	Name	Trained (DMAT)	Trained (NBC)	Estimated Arrival	Arrival	Assigned Section	Arrival Confirmation
1	Physician	Surgery/ER	Fellow	12	Hira E	○	○	20:15	○	Immediate Area	Input
2	Physician	Surgery	Fellow	8	Shinozaki K	○	○	20:17	○	Immediate Area	Input
3	Physician	Surgery	Resident	3	Mizushima Y	-	-	20:24	○	Immediate Area	Input
4	Nurse	Ward	Head Nurse	15	Kajiwara N	-	-	20:13	○	Immediate Area	Input
5	Nurse	Ward	Staff	9	Fujiwara Y	-	-	20:14	○	Immediate Area	Input
6	Nurse	Ward	Staff	6	Ueyama S	-	-	20:36	○	Immediate Area	Input
7	Logistician	Human Resources	Staff	6	Yoshimoto K	-	-	20:16	○	Immediate Area	Input

Back to Current Status of Assignment

Fig. 2. System screen of assigned section.Panel A: Overview table of assigned section.http://www.cereja.co.jp/dcs/Assigned_Section_Overview.htmlPanel B: Detailed information about assigned section.http://www.cereja.co.jp/dcs/Assigned_Section_Detail.html

the assignment without errors using both the ICT system and a conventional manual approach. However, the ICT system was significantly more rapid than the conventional manual approach in assigning 30 staff members ($P = 0.0016$; Fig. 4D).

To ensure that a hospital's disaster control headquarters conduct an effective initial response, it is crucial that they notify in-house hospital staff, provide the necessary information, and receive responses from those staff [8]. Although the phone tree approach does enable direct verbal communication between individuals, it results in lost time accuracy. In fact, in a US survey, only 43% of respondents considered the phone tree an effective method of contacting in-house staff in a disaster situation [14].

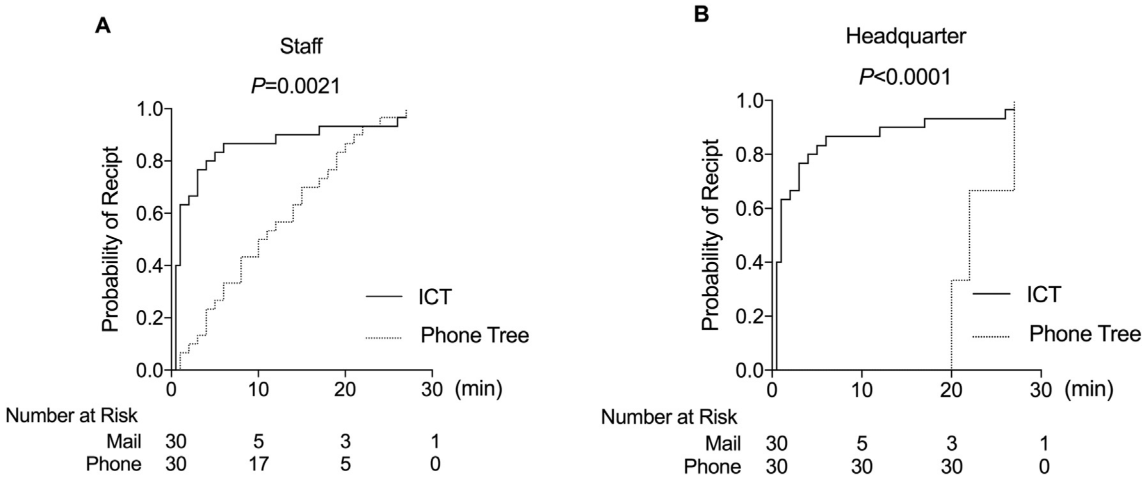


Fig. 3. Kaplan–Meier probability curve of receipt. Panel A: Staff outside hospital. Panel B. Headquarters.

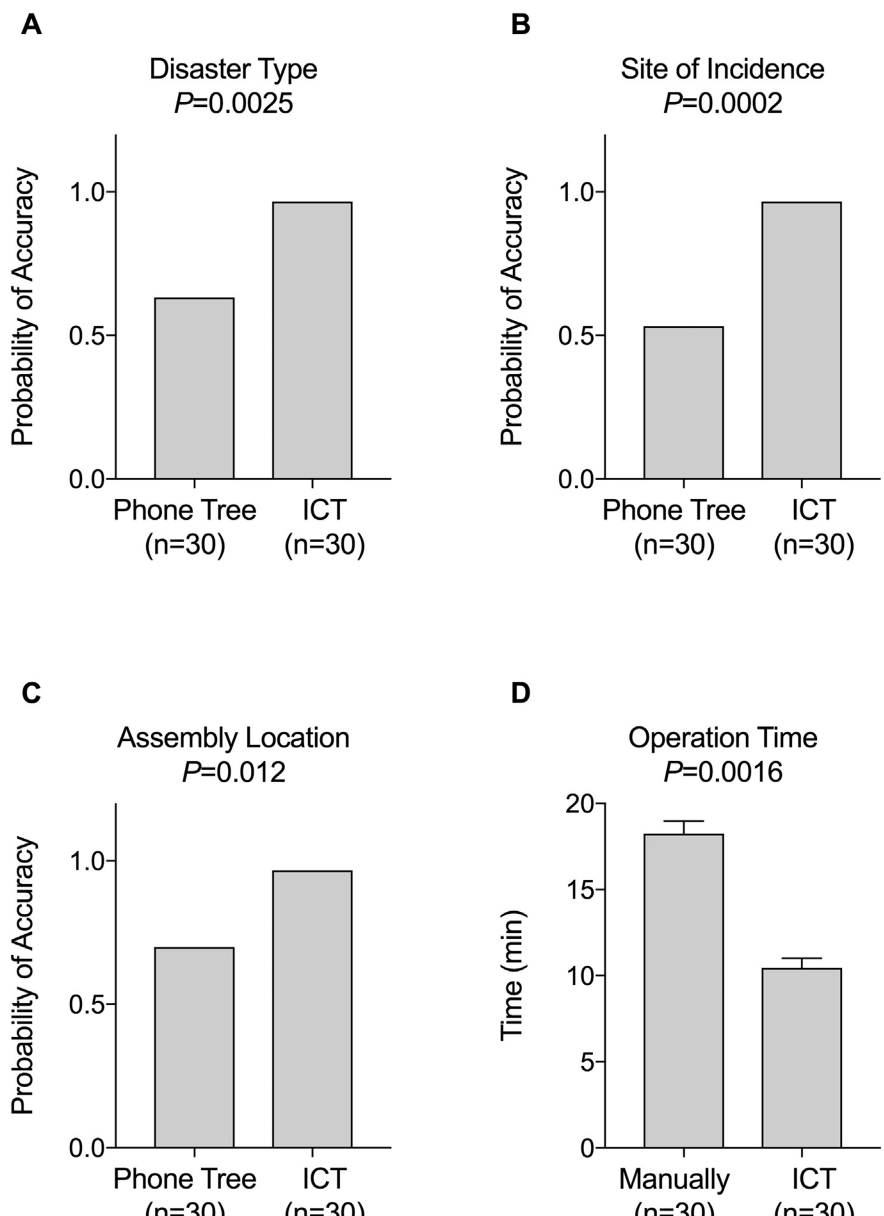


Fig. 4. Accuracy and quickness of transmitted information. Panel A: Information about disaster type. Panel B: Information about site of incidence. Panel C: Information about assembly location. Panel D: Operation time of personnel assignment simulation.

In keeping with their prevalence, mobile phones have been used to improve the initial hospital response to disasters [13, 20]. Specifically, the utility of short message service (SMS) text messaging to notify medical staff has been tested in a simulated mass casualty incident using a ready-made SMS mobile phone application [11, 13]. The studies showed that the simultaneous transmission to multiple persons—a basic ICT function—is effective. Similarly, our study showed the utility of simultaneous transmission using ICT. Moreover, our system had several advantages over existing mobile phone applications such as SMS text messaging or messenger applications. Firstly, ICT can notify thousands of people at once, whereas SMS text messaging or messenger applications are limited in the number of destinations which a single message can simultaneously send to [21]. Secondly, our system enables a user with an insufficient experience to transmit information easily, quickly, and accurately, with contents that are both necessary and sufficient without opening the instruction manual. Furthermore, the system was designed with various considerations and specialized to provide high effectiveness during the initial response to disaster. For example, to promote a prompt system activation by headquarters who are uncertain whether they need to send a request of attendance during the initial phase due to insufficient information, the input screen for system activation has a predefined format of a standby request. To provide flexibility, users can select the destination of each transmission from a list of staff categories by clicking a button. To prevent notification failure, the system repeatedly sends e-mail requests after activation (e.g., every 5 min).

We also developed the system to facilitate subsequent assignment of staff members who have arrived at the assembly point. Specifically, the system was designed so that the headquarters of hospital disaster control could easily and quickly place staff by checking the inputted information necessary to optimal personnel assignment. The present study results showed that the system significantly shortened operation times.

To conclude, our novel ICT system transmitted information more accurately and promptly to staff. Headquarters more quickly received staff responses and the information was effectively utilized for subsequent personnel assignment. It appears that the system improves staff resource management during the initial hospital response to a major incident.

Support/funding

None to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajem.2018.06.007.

Mami Yamada, MD
Rinku General Medical Center, Senshu Trauma and Critical Care Center, 2-23 Rinku Orai Kita, Osaka 598-8577, Japan

Taka-aki Nakada, MD, PhD
Rinku General Medical Center, Senshu Trauma and Critical Care Center, 2-23 Rinku Orai Kita, Osaka 598-8577, Japan
Chiba University Graduate School of Medicine, Department of Emergency and Critical Care Medicine, 1-8-1 Inohana, Chuo, Chiba 260-8677, Japan
Corresponding author at: Chiba University Graduate School of Medicine, Department of Emergency and Critical Care Medicine, 1-8-1 Inohana, Chuo, Chiba 260-8677, Japan.
E-mail address: taka.nakada@nifty.com.

Shota Nakao, MD
Rinku General Medical Center, Senshu Trauma and Critical Care Center, 2-23 Rinku Orai Kita, Osaka 598-8577, Japan
Eiji Hira, MD
Rinku General Medical Center, Senshu Trauma and Critical Care Center, 2-23 Rinku Orai Kita, Osaka 598-8577, Japan
Shimane University Faculty of Medicine, Department of Acute Care Surgery, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan

Koichiro Shinozaki, MD, PhD
Chiba University Graduate School of Medicine, Department of Emergency and Critical Care Medicine, 1-8-1 Inohana, Chuo, Chiba 260-8677, Japan
The Feinstein Institute for Medical Research, Northwell Health, 350 Community Dr., Manhasset, NY 11030, United States

Rui Kawaguchi, MD
Chiba University Graduate School of Medicine, Department of Emergency and Critical Care Medicine, 1-8-1 Inohana, Chuo, Chiba 260-8677, Japan

Yasuaki Mizushima, MD, PhD
Tetsuya Matsuoka, MD, PhD
Rinku General Medical Center, Senshu Trauma and Critical Care Center, 2-23 Rinku Orai Kita, Osaka 598-8577, Japan

24 May 2018

https://doi.org/10.1016/j.ajem.2018.06.007

References

[1] Ushizawa H, Foxwell AR, Bice S, Matsui T, Ueki Y, Tosaka N, Shoko T, Aiboshi J, Otomo Y. Needs for disaster medicine: lessons from the field of the Great East Japan Earthquake. Western Pac Surveill Response J 2013;4:51–5.
[2] Nagata T, Rosborough SN, VanRooyen MJ, Kozawa S, Ukai T, Nakayama S. Express railway disaster in Amagasaki: a review of urban disaster response capacity in Japan. Prehosp Disaster Med 2006;21:345–52.
[3] Turegano-Fuentes F, Caba-Doussoux P, Jover-Navalon JM, Martin-Perez E, Fernandez-Luengas D, Diez-Valladares L, Perez-Diaz D, Yuste-Garcia P, Guadalajara Labajo H, Rios-Blanco R, et al. Injury patterns from major urban terrorist bombings in trains: the Madrid experience. World J Surg 2008;32:1168–75.
[4] Gates JD, Arabian S, Biddinger P, Blansfield J, Burke P, Chung S, Fischer J, Friedman F, Gervasini A, Goralnick E, et al. The initial response to the Boston marathon bombing: lessons learned to prepare for the next disaster. Ann Surg 2014;260:960–6.
[5] Gregory TM, Bihel T, Guigui P, Pierrart J, Bouyer B, Magrino B, Delgrande D, Lafosse T, Al Khaili J, Baldacci A, et al. Terrorist attacks in Paris: surgical trauma experience in a referral center. Injury 2016;47:2122–6.
[6] Campion EW, Morrissey S, Malina D, Sacks CA, Drazen JM. After the mass shooting in Las Vegas - finding common ground on gun control. N Engl J Med 2017;377:1679–80.
[7] Read DJ, Holian A, Moller CC, Poutawera V. Surgical workload of a foreign medical team after Typhoon Haiyan. ANZ J Surg 2016;86:361–5.
[8] Kaji AH, Koenig KL, Lewis RJ. Current hospital disaster preparedness. JAMA 2007;298:2188–90.
[9] Hick JL, Koenig KL, Barbisch D, Bey TA. Surge capacity concepts for health care facilities: the CO-S-TR model for initial incident assessment. Disaster Med Public Health Prep 2008;2(Suppl 1):S51–7.
[10] Sylvester KW, Rocchio MA, Belisle C, Matta L, Goralnick E. Pharmacy response to the Boston Marathon Bombings at a Tertiary Academic Medical Center. Ann Pharmacother 2014;48:1082–5.
[11] Murray MJ. Communicating during a disaster. Anesth Analg 2010;110:657–8.
[12] Chan TC, Killeen J, Griswold W, Lenert L. Information technology and emergency medical care during disasters. Acad Emerg Med 2004;11:1229–36.
[13] Timler D, Bogusiak K, Kasielska-Trojan A, Neskoromna-Jedrzejczak A, Galazkowski R, Szarpak L. Short text messages (SMS) as an additional tool for notifying medical staff in case of a hospital mass casualty incident. Disaster Med Public Health Prep 2016;10:38–41.
[14] Thompson T, Lyle K, Mullins SH, Dick R, Graham J. A state survey of emergency department preparedness for the care of children in a mass casualty event. Am J Disaster Med 2009;4:227–32.
[15] Latifi R, Tilley EH. Telemedicine for disaster management: can it transform chaos into an organized, structured care from the distance? Am J Disaster Med 2014;9:25–37.
[16] Doarn CR, Merrell RC. Telemedicine and e-health in disaster response. Telemed J E Health 2014;20:605–6.
[17] Tanaka K, Nakada TA, Fukuma H, Nakao S, Masunaga N, Tomita K, Matsumura Y, Mizushima Y, Matsuoka T. Development of a novel information and communication technology system to compensate for a sudden shortage of emergency department physicians. Scand J Trauma Resusc Emerg Med 2017;25:6.
[18] Bates DW, Gawande AA. Improving safety with information technology. N Engl J Med 2003;348:2526–34.
[19] Ajami S, Lamoochi P. Use of telemedicine in disaster and remote places. J Educ Health Promot 2014;3:26.

[20] Epstein RH, Ekbatani A, Kaplan J, Shechter R, Grunwald Z. Development of a staff recall system for mass casualty incidents using cell phone text messaging. Anesth Analg 2010;110:871–8.
[21] Windokun A, Hamid Z. Development of a staff recall system for mass casualty incidents using cell phone text messaging. Anesth Analg 2010;111:581–2.

Gastric ultrasonography in evaluating NPO status of pediatric patients in the emergency department

Pulmonary aspiration of gastric contents is uncommon but still considered a potential risk in patients who may require emergent intubation or procedural sedation [1, 2]. This normally occurs during induction, which tends to be technically variable for pediatric patients. The incidence of pulmonary aspiration is about four to ten times higher in pediatric populations than adults [3, 4]. Typically, preprocedural fasting time is recommended and used to determine the risk of aspiration. The American Society of Anesthesiology (ASA) 2011 Practice Guidelines recommends at least a 2-hour wait for clear fluids and 6 h for solid foods prior to general anesthesia [5]. However, NPO status is not an independent predictor of aspiration and a definitive assessment of gastric contents and NPO status in pediatric patients is either unavailable in emergency department (ED) [3, 6].

Given the variations in reliability of parent/self-reported NPO status and gastric emptying times, NPO status may not truly reflect whether or not contents are present in the stomach. In an effort to assess the application of point-of-care-ultrasound (POCUS) in detecting gastric contents, we conducted a prospective observational study at an academic pediatric emergency department (ED). We postulated that gastric US may offer an objective, alternative approach to assessing gastric contents in pediatric patients. Gastric US has been reported as highly sensitive and specific to detect or rule out gastric contents [7, 8].

In this study, we included patients aged 2 to 18 years with no prior history of esophageal or gastric surgery, hernia, or diabetes. After obtaining informed consents from the parent or legal guardian, EM US fellows performed gastric US on each patient. The sonographers were blinded to the patient's time of the last ingestion and only gathered that data after performing and storing the US images. Either a Sonosite M-Turbo or a Mindray® M-9 with curvilinear probe was used to perform gastric ultrasonography. Patients were placed in a right-lateral decubitus position, which is the position that can detect minimal fluid volume, and the antrum of the stomach was viewed in a sagittal orientation (Fig. 1). The gastric antrum was scanned and measured and the presence and type of contents (fluid versus solid) determined. The US images were then reviewed by two EM attending sonographers independent of each other and blinded to the other study data to assess reproducibility.

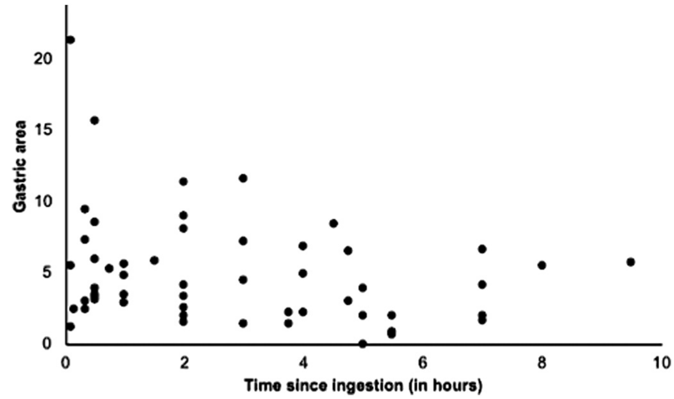


Fig. 2. Correlation of gastric area and time since oral food or drink ingestion.

1. Ultrasound findings

In this group of pediatric patients, we were able to demonstrate the use of US images of the gastric antrum to distinguish the presence or absence of gastric contents. Overall, we detected gastric contents in 83% of patients (43/52). In 69% of patients ($n = 36$), gastric US was able to detect expected gastric contents based on positive meal history. In 13% ($n = 7$) ultrasound showed gastric contents in patients who were NPO by history. In another 13% ($n = 7$) patients were not NPO by history but US showed no gastric contents. In only 22% (2/9) of patients who reported an NPO status were no gastric contents seen. In patients where US showed gastric contents, the average time since last ingestion was 2.3 h for any type and 4.7 h for solid foods. Fig. 2 shows a significant yet modest negative correlation between the gastric area observed on US and time since ingestion of solids and liquids (Pearson $r = -0.24$, $P_{\text{one-tailed}} = 0.04$). Both reviewers agreed on US findings in 49 out of 52 patients with a weighted kappa of 0.90.

2. How reliable is the self-reported NPO?

In 52 patients who were included in this study, only 9 patients (17%) reported no food/liquid intake in past 2–6 h. The estimated sensitivity of gastric US was 84% (95% CI 69–93%) and specificity was 22% (95% CI 4–60%) when compared to patient anamnesis as a gold standard. The positive likelihood ration (LR+) was 1.08 (95% CI 0.74–1.56) and the negative likelihood ration (LR−) was 0.73 (95% CI 0.17–3.09).

This suggests gastric contents as seen on US correlated only modestly with patient history of ingestion. In 26% of patients there was discordance between the gastric US findings and the self-reported NPO status. There were only two instances where the patient's history aligned with the negative finding of gastric contents on US.

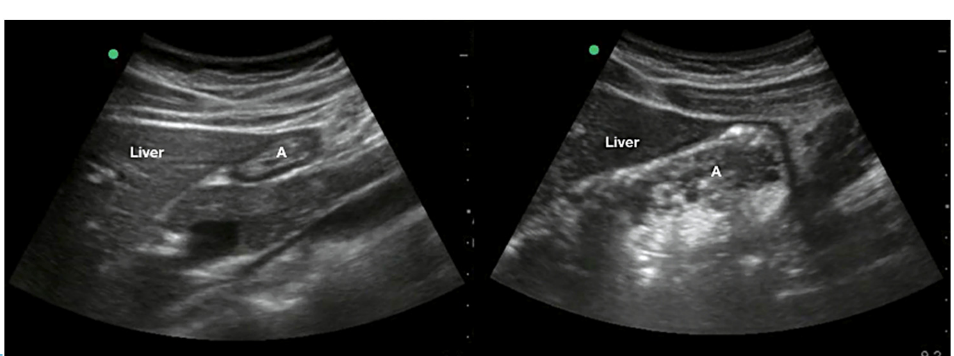


Fig. 1. Ultrasound scans of an empty and content-filled gastric antrum.