

State of Simulation in Healthcare Education: An Initial Survey in Beijing

Zichen Zhao, MD, Pengfei Niu, MD, Xiang Ji, MD, Robert M. Sweet, MD

ABSTRACT

Background and Objectives: In 2013, medical error was the third leading cause of death in the United States.¹ In China, as in the case with the United States, training and assessment are developing as a strategy to reduce the occurrence of such errors. The objective of this study was to assess the current state of the use of simulation-based training in Beijing and to explore the barriers to further development.

Methods: This study included hospitals in Beijing accredited by the Standardized Residency Training (SRT) program. The questionnaire was designed online and distributed to the SRT management departments by e-mail or instant message.

Results: Thirty hospitals were invited to participate in this survey, and 15 responses were completed and met the inclusion criteria. Task trainers (15/15), full-scale mannequins (14/15), standardized patients (12/15), and virtual reality workstations (11/15) were the most common types of simulation modalities available for use. Among the given specialties for SRT, the availability of simulation courses was 2/2 for pediatric internal medicine, 1/1 for pediatric surgery, 10/11 for surgery, 11/14 for internal medicine, 7/9 for anesthesiology, 6/8 for emergency med-

icine, and 3/9 for obstetrics/gynecology. Of the 13 institutions with available simulation curricula, 12/13 had simulation focused on proficiency-based skill training, 11/13 had medical knowledge learning, 10/13 had skill competency assessment. The main targeted trainees in these hospitals were residents (or postgraduate residents) and medical students (or interns). The top 2 barriers were the shortage of sustainable financial resources (12/15) and advocacy from their institutional authorities (7/15).

Conclusion: It is evident that there is a need for more development of training facilities, and for training the “trainers” and administrators. Financial funding, curricular design, and research seem to be crucial for building a long-term, sustainable, effective program.

Key Words: China, Curriculum, Education, Simulation training, Survey, Patient safety.

WWAMI Institute for Simulation in Healthcare (WISH), University of Washington, Seattle, Washington, USA (Drs Zhao and Sweet).

Department of General Surgery, Peking University Shougang Hospital, Beijing, China (Dr Niu).

Urology Department, Wujieping Urology Center, Peking University Shougang Hospital, Beijing, China (Dr Ji).

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Address correspondence to: Robert M. Sweet, MD, WWAMI Institute for Simulation in Healthcare, University of Washington, Box 356410, 1959 NE Pacific Street, Seattle, WA, 98195, USA. Telephone: +1-206-221-4905, Fax: +1-206-543-3272, E-mail: rsweet@uw.edu

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INTRODUCTION

In 2013, there were 251,454 deaths in the United States stemming from medical error, which made medical error the third leading cause of death.¹ While published data are lacking from China, it is an important problem to be addressed.

Simulation, as a valid and safe adjunct modality in healthcare education, is widely embraced by academic medical centers around the world. It provides a no-risk platform for learners, not only to acquaint themselves with and develop new skills, but also to refine and perfect their skills to achieve expertise and mastery.² When integrated into medical education, simulation not only enables the trainees to bypass the early error-prone period and reduce the length of the learning curve,³ but also secures the safety of patients.⁴ Simulation is being used to train and assess all of the domains that are linked to performance in healthcare, including technical and nontechnical skills for both individuals and healthcare teams.

Simulation as a solution for training and assessment is a worldwide phenomenon that is beginning to evolve in China, the world's most populous country. An assessment

of the state and need for simulation-based education in China has not been published in the literature. The purpose of this study was to assess the current status of the use of simulation-based training in Beijing, identify the availability and adequacy of simulation resources, assess financial capacity, investigate where simulation is being used, and explore the barriers to further development.

MATERIALS AND METHODS

The study included hospitals in Beijing accredited by the Standardized Residency Training (SRT) program. The list of the potential qualified hospitals was obtained from the Beijing SRT management system website. Hospitals accredited for at least 1 of the core specialties/disciplines during 2015 were selected for the study. These specialties/disciplines included anesthesiology, emergency medicine, internal medicine, obstetrics-gynecology (OB/GYN), pediatric internal medicine, pediatric surgery, and surgery. Hospitals qualified only for the SRT in clinical pathology, dermatology, family medicine, laboratory medicine, medical imaging, neurology, oncology, ophthalmology, otorhinolaryngology, pharmacy, psychiatry, rehabilitation medicine, or stomatology were excluded in this study.

The survey was conducted in 2016. A questionnaire was designed online at www.wenjuan.com. Participants were queried as to the status of their organizations from January 1, 2015, to December 31, 2015. Survey invitations with website links were sent to the SRT management departments by e-mail or instant message from May through June of 2016. Hospitals that voluntarily responded and consented to the nondisclosure agreement were included.

Survey

Demographic data were collected. Survey question methodology included single-choice and multiple-choice questions (one or more answer) and semantic differential scale questions. Demographic classification of trainees as surgeons or physicians in practice (attending or above), residents (or postgraduate residents), fellows, medical students (or interns), nurses, and allied health professionals was performed.

We assessed the availability of simulation equipment, curricula, and identification of the targeted learners. Respondents were asked to indicate all the available simulation equipment at their organizations. The categories of simulation equipment in this survey included standardized patients, full-scale mannequins, ex vivo animal tissue models, live animals, human cadavers, synthetic task

trainers (or bench-top models), screen-based virtual reality (VR) workstations and online simulation modules.

To examine the curricula, the survey divided simulation-based educational activities into several areas, such as learning medical knowledge, practice-based skill training, skill competency evaluation, doctor-patient communication, leadership and teamwork, critical thinking and decision-making, patient safety, health advocacy, medical ethics, curriculum validation, and follow-up of learners. The aim was to identify how many domains were performed in their courses. The questionnaire also collected the availability of existing simulation curricula in different specialties.

The survey also assessed infrastructure support, such as the affiliations of their simulation department, accreditation status, financial capacity, and the availability of specialized simulation-trained staff.

Finally, it queried their attitudes, needs and perceived barriers in the development of simulation programs.

RESULTS

Thirty hospitals were invited to participate in the survey, and 15 of them (50% response rate) replied and completed the questionnaire. All of their questionnaires were complete and met the inclusion criteria. All of the respondents were tertiary hospitals. Of these 15 hospitals, the qualification rate for SRT in each specialty were internal medicine 93.33% (14/15), surgery 73.33% (11/15), anesthesiology 60% (9/15), OB-GYN 60% (9/15), emergency medicine 53.33% (8/15), pediatric internal medicine 13.33% (2/15), and pediatric surgery 6.67% (1/15).

Simulator, Curriculum, and Learner

All of the institutions were equipped with simulation equipment. Task trainers (15/15), full-scale mannequins (14/15), standardized patients (12/15), and VR workstations (11/15) were the top 4 common types of simulation modalities available for use, followed by ex vivo animal tissue models (8/15), live animal models (7/15), and an online simulation module (1/15). None of them used human cadavers for simulation training.

The most commonly available task trainers (or bench-top models) in these institutions were cardiopulmonary resuscitation torso trainers (15/15), incision and suturing models (14/15), and heart and lung sound-recognition models (12/15), followed by genitourinary models (11/15), airway management models (11/15), vascular access models (10/

15), lumbar puncture models (8/15), and nasogastric tube models (8/15).

Of the 14 hospitals that owned the full-scale mannequin, most had basic adult mannequins without physiology (12/14); 8/14 had mannequins with physiology. Four of them had pediatric mannequins without physiology, and only 1 owned pediatric mannequins with physiology; 1 had basic infant mannequins and 1 owned infant mannequins with physiology.

The top 2 available VR simulators in these 9 hospitals were for laparoscopic skills (9/11), and gastrointestinal (GI) endoscopy skills (5/11), followed by urologic endoscopy skills (4/11), arthroscopic skills (3/11), bronchoscopic skills (3/11), and endovascular skills (2/11).

Among the given specialties for SRT, the availability of simulation courses was 100% (2/2) for pediatric internal medicine, 100% (1/1) for pediatric surgery, 90% (10/11) for surgery, 78.57% (11/14) for internal medicine, 77.78% (7/9) for anesthesiology, 75% (6/8) for emergency medicine, and 33.33% (3/9) for OB/GYN (Figure 1). Some institutes had simulation curricula, even though they were not qualified for SRT in the given disciplines. There were 2 hospitals without any available training course in any of the listed specialties.

Of the 13 institutions with available simulation curricula, 12 had simulations focused on proficiency-based skill training, 11 had medical knowledge learning, and 10 had skill competency assessment. Simulation was cited less for patient safety (6/13), leadership and teamwork (5/13), trainee follow-up (5/13), doctor-patient communication

(4/13), critical thinking and decision-making (3/13), and curriculum validation (3/13), and even less frequently for medical ethics (1/13). None of the hospitals included health advocacy in their simulation courses.

All of the 13 hospitals with available simulation courses targeted residents or postgraduate residents as their trainees. Most of them targeted medical students or interns (12/13), fellows (9/13), practicing surgeons or physicians (8/13), and nurses (7/13). Allied health professionals (1/13) and high school students (1/13) were the target learning audience in 1 hospital.

Infrastructure Support

Simulation-based curricula or courses were not compulsory in the SRT program in Beijing; hence, the hospitals do not need an accredited simulation department to be accredited for the SRT program. Only one of these 14 simulation department was accredited by the Ministry of Health, the rest of them were not accredited by any organization or society. Thirteen of the 15 departments were affiliated with their hospitals; the remaining 2 were affiliated with universities or colleges. The simulation facilities in the majority of them (14/15) were centralized in a specific department within their institutions. Only 1 of them was a separate entity from the clinical departments.

The respondents were asked to select all the financing sources for their simulation units. The majority (14/15) indicated that they were financed by their hospitals or clinical departments. Some of them also reported financial support from medical universities or colleges (5/15). Few

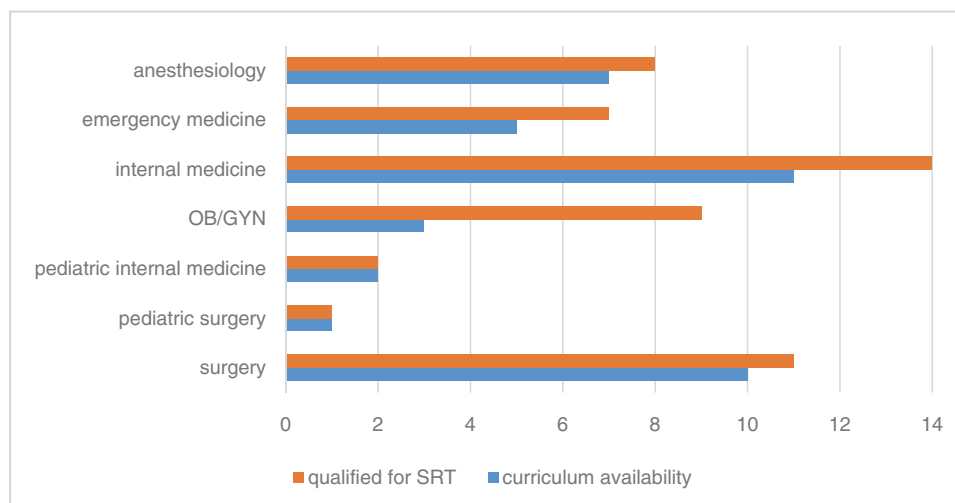


Figure 1. Qualified hospitals for STR and availabilities of simulation curriculum in the given specialties.

of them had economic support from grants or foundations (2/15), governments (2/15), or for-profit entities (1/15). None of them received funding from philanthropy.

Concerning human resources for simulation programs (Figure 2), most of the 14 hospitals had full-time (10/15) and part-time (11/15) clinical directors, full-time (8/15) and part-time (9/15) administrators, and part-time instructors (13/15). The full-time instructors (3/15), part-time researchers (2/15), and full-time (2/15) and part-time (4/15) information technology (IT) specialists and technicians were available in some organizations. However, there was no full-time researcher for simulation in any of the hospitals surveyed. The researcher's role was to design projects and analyze data for simulation activities.

The center of Figure 2 represents 0, and the percentages increase by 20% as the pentagon progress outward with the outline representing 100%.

Barriers

A 5-point Likert scale was used to assess participants' attitudes toward the sufficiency of simulation resources at their institutions. One point represented "extremely insufficient" while 5 points represented "extremely sufficient." The mean score was 2.93, and none of the participants thought the simulation resources were extremely sufficient or insufficient.

The necessity of simulation for healthcare was examined with a Likert scale. One point indicated "totally unnecessary", while 5 points represented "highly necessary." The mean score was 4.07. The participants' attitudes toward the given factors that may affect the development of simulation programs were demonstrated in Figure 3.

The respondents were asked to point out the barriers in their simulation programs (Figure 4). The top 2 barriers were the shortage of sustainable financial resources (12/15) and advocacy from their institutional authorities (7/15). Some of them indicated the insufficiency of research programs (6/15), curricula (6/15), clinical instructors with protected time (6/15), dedicated IT specialists and technicians (4/15), trainees' need (3/15), and endorsement by local healthcare authorities (2/15).

The center of Figure 4 represents 0, and the percentages increase by 20% as the nonagon progresses outward, with the outline representing 100%.

DISCUSSION

Simulation among the high-ranking SRT hospitals in Beijing is clearly important, underresourced, and in demand. All of the 15 hospitals included in the study are tertiary hospitals, which are the top-ranking hospitals on the Chinese mainland.

Patient outcomes are linked to high-performing teams and individuals in healthcare. Simulation is being used worldwide for both technical and nontechnical skills and is emerging as an important modality in China. Issues specific to China include an increasingly strained relationship between doctors and patients,^{5,6} in which patients do not trust their doctors and even refuse to be operated on by resident surgeons. This, and the relatively limited clinical rotation "hands-on" time in each specialty and the enormously discrepant distribution of case volumes all ultimately contribute to the relatively unequal or insufficient exposure for learners in medical practice. Simulation has a profound ability to provide significant advantages as a

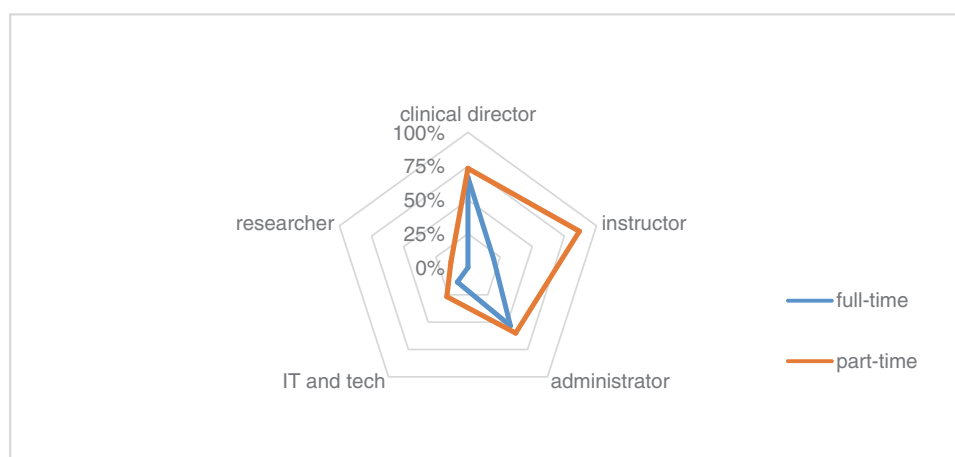


Figure 2. Staff configuration.

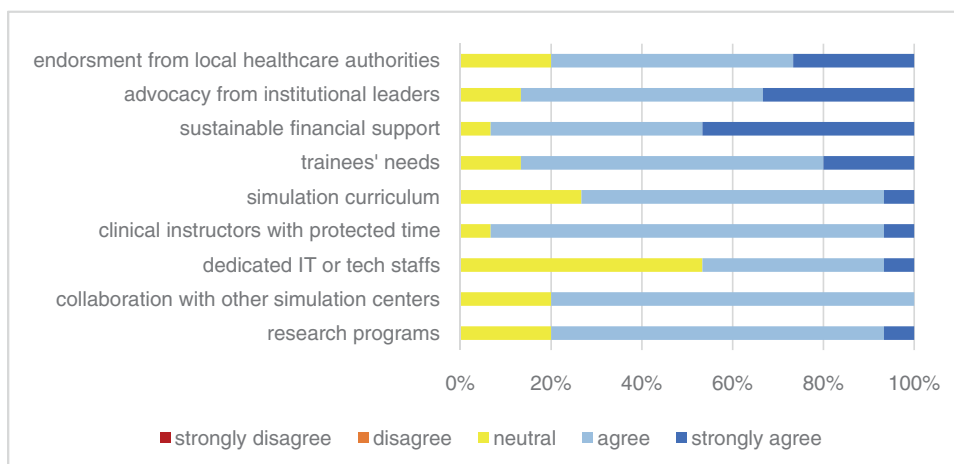


Figure 3. Factors affecting the development of simulation programs.

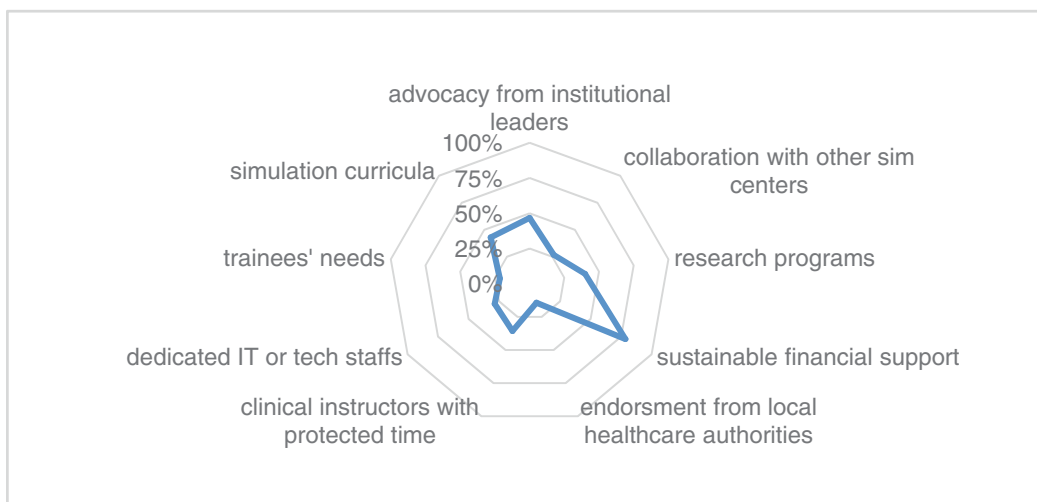


Figure 4. Barriers in simulation.

platform for repetitive practice in a no-risk environment away from patients.² The specialties included in this study are the ones where simulation-based training had been broadly used internationally.

Simulator, Curriculum, and Learner

The most common simulation equipment in the responding hospitals were task trainers, basic or advanced full-scale mannequins, standardized patients, and VR simulators. The quantities of simulators, curricula, and trainees were not asked for in the survey, as most of the hospitals in Beijing did not have an independent simulation department. The availability of simulators may not reflect the exact frequency of use or activities of an institution, but these types of simulators are universally applicable in

primary specialties, and they could meet the common needs of novices in a clinical rotation if embedded within a well-designed simulation curriculum. Most of the respondents (11/15) agreed or strongly agreed that curriculum is one of the influence factors in simulation education and training, and 40% (6/15) of them indicated that the shortage of curriculum was one of the barriers in their simulation program. To fully take advantage the benefit of simulation, proficiency-based training should not be a single method of education, but instead, must be integrated into a comprehensive curriculum. The equipment available and purchased will directly follow the curricular needs.

According to this survey, in Beijing, the focus for application of simulation is primarily for competency-based tech-

nical skills training, medical knowledge learning, and competency assessment. Despite evidence that 70% of medical errors occur within the communication domain,⁷ fewer than half of the programs included patient safety and nontechnical skills, such as leadership, teamwork, communication, decision-making, and critical thinking. This finding was in contrast to the United States and Europe, where simulation is frequently used to address these competencies. Healthcare is a “team sport,” and to achieve a good patient outcome, technical ability must be complemented by excellent, nontechnical skills across the entire team taking care of the patient.^{8,9} To fully integrate patient safety into the curriculum, simulation programs should work closely with risk management, patient safety committees, and hospital administrations to pointedly address problems of patient safety.¹⁰

The main targeted trainees in these hospitals were residents (or postgraduate residents) and medical students (or interns). Novices are always the target audience in simulation training, because premature exposure to patients often results in increased complication rates related to suboptimal technical skills.^{11,12} Simulation training can help novices to maximize their practice time and ensure that they get as much technical exposure as possible.¹³ As nontechnical skills have not been found to necessarily correlate with experience, more advanced trainees and practitioners may also benefit from simulation training.¹⁴ Either novices or physicians who want to develop new skills or maintain their skills could be the eligible trainees in a comprehensive simulation course.

Research and scholarly focus for the programs were surprisingly low. Only 23.08% (3/13) of the institutions reported validation activities in their simulation courses, and only 1 had published articles related to simulation in 2015. First, for a simulator to be used to assess competence, it must be evaluated vigorously and objectively to determine its reliability and validity.¹⁵ Second, one of the most significant incentives of simulation in medical education is that simulation can improve patients’ outcomes by minimizing preventable mistakes, and research or academic activities are therefore also necessary for advocating the superiority of simulation-based medical education.

Hence, a qualified simulation curriculum should be well designed and validated; it should be composed of both technical and nontechnical skills training. With such a course, the real value of simulation would be appreciated.

Infrastructure Support and Barriers

As most of their simulation departments were centralized and affiliated with their hospitals, the financing mainly came from their hospitals or clinical departments. According to this study, one of the most frequent barriers they encountered in their development was a lack of sustainable funding sources (12/15), and most of the respondents (14/15) indicated that the funding was one of the factors that may influence the growth of simulation programs. Simulation education and training in healthcare could improve patients’ safety,^{4,16,17} and most respondents (13/15) held a positive attitude toward the necessity of simulation in healthcare education. However, few of them (3/15) thought that simulation training resources were sufficient at their organizations.

Given the massive investment up front, the on-going consumption, and the time needed for validating the curriculum, simulation may fail to demonstrate the return on investment in the short term. The return is difficult to “monetize,” which may be the reason that simulation commonly fails to acquire adequate support from the authorities at their hospitals. However, taking into consideration that one of the benefits of simulation is to reduce the cost of the complications and malpractice suits of preventable mistakes, the savings could pay for an entire program.

A Beijing Simulation Alliance?

For Beijing, coordination and cooperation among simulation centers seems to be a plausible solution for optimizing the allocation of resources to serve its large population of healthcare workers and teams. They could share curriculum and experience and leverage one another’s existing simulation resources. Basic questions around simulation-based education cannot be answered without strong collaboration among simulation centers for increased funding support, faculty training, generating guidelines, and changing policies.¹⁰ They could also launch multi-center validation or research to demonstrate the benefits of simulation for introduction of new technology, entry into training programs, training, and even credentialing. Showing links to improved patient outcomes may ultimately compensate for the governments’ or authorities’ expenditure by reduction of preventable medical errors in the long run. The need for curricula, research program, and cooperation with other centers were also demonstrated in this study (**Figure 4**).

As indicated in this survey, 46.67% participants felt there to be insufficient support from their institutions: 86.67%

thought such advocacy from their institutions could influence their simulation programs. Most of them had both full-time and part-time clinical directors and administrators. However, as most of the instructors are part-time in their simulation departments, the deficiency of instructors with protected time was cited as a major obstacle; 93.33% of them believed that dedicated teachers could positively influence their simulation programs. In China, the clinical directors and instructors drive the research, so the part-time status may be a contributor to the lack of emphasis on research.

Volunteer trainees with an active willingness to participate in simulation training represent a minority. The leaders of simulation programs should promote their simulation-based medical curricula through carefully designed studies linking training to patient outcomes and improving the healthcare team's competency and efficiency. As validating evidence accumulates, simulation programs will become mandatory in Beijing.

In summary, it is evident that there is a need for careful development of training facilities, training the "trainers" and administrators, financial funding, and curricular design (including theory and practical teaching), and research to continue to build a long-term, sustainable, effective program.

Limitations

This survey had several limitations. Because the questionnaires were distributed through e-mail or instant message and completed online, the expectation of the time spend on completing the survey, and the complication of the items was confining to some extent. The majority of hospitals in Beijing did not have an independent simulation department. Therefore, it was not feasible to investigate quantitative data on the online survey, such as the number of trainees and simulation equipment in each category, the quantitative degree of integration of simulation into their medical education, the priority of teaching content areas in simulation activities, the contact hours (the hours spent on training) for different types trainees, and the frequency of use of simulation facilities. We could not guarantee all the respondents were the director or administrator of their simulation departments, which could introduce bias into the result. The information provided by the respondents were assumed accurate because we had not confirmed them by further investigation.

CONCLUSION

The results of this survey indicated that most of the participating hospitals had simulation facilities. The primary targeted audiences were residents (or postgraduate residents) and medical students (or interns). Internal medicine, surgery, and anesthesiology were the 3 most common specialties where simulation training was used. Most programs had simulation training courses already. The teaching content domains should be refined, and there should be a greater emphasis on nontechnical skills. The research activities in simulation programs should also be enhanced. The simulation education and training in most if them had a shortage of research, sustainable financial resources, and endorsement from their authorities. The building of a consortium and leadership specializing in the science of simulation would help bridge the gaps.

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