INSTRUCTIONAL DESIGN AND ASSESSMENT

Vital Sign Monitoring Using Human Patient Simulators at Pharmacy Schools in Japan

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Objective. To develop, implement, and assess an experience-based education program using human patient simulators to instruct pharmacy students in monitoring vital signs to identify drug treatment effects and adverse events.

Design. Medical emergency care programs using human patient simulators were prepared and facilitated practical clinical training in resuscitation, which required selecting drugs while monitoring changes in blood pressure, pulse, and arterial blood oxygen saturation. Training encompassed the monitoring of routes of drug administration, drawing of simulated blood, vital-sign monitoring based on a pharmaceutical universal training model, vital-sign monitoring devices and simulators, and medical emergency education using biological simulators.

Assessment. Before and after bedside training, students were asked to complete a questionnaire to assess their understanding of vital sign monitoring and emergency care. Students successfully learned how to monitor routes of drug administration, vital signs, and pathological conditions. There was a significant increase in students’ recognition of the importance of vital-sign monitoring.

Conclusion. Experienced-based training using patient simulators successfully prepared pharmacy students to monitor vital signs and identify drug treatment effects and adverse events.

Keywords: human patient simulator, vital signs, medical emergency care, practice experience, simulation

INTRODUCTION

In Japan, pharmacy education was redirected to focus on clinical instruction upon the transition to a 6-year pharmacy school curriculum in April 2006. 1 Previously, education had focused on the acquisition of basic pharmaceutical knowledge (mainly chemistry and biology) and clinical pharmaceutical education was not a major aim. However, when pharmacists began drug management guidance at medical facilities, they began to come in frequent contact with patients, physicians, and nurses. Drug management guidance involves instructing patients at their bedside in the use of drugs. It also encompasses the provision and recording of medication information in response to requests from physicians. A drug management guidance fee for services that meet specified conditions based on the patient’s insurance score may be charged to Japan’s Social Insurance Agency of the Ministry of Health, Labour and Welfare.

In Japan, academic institutions certify pharmacists who have finished specified training, given presentations, published reports, passed examinations as specialists of drugs, and displayed broad knowledge and sufficient technical skills. Those with sufficient knowledge and technical skills also are certified to be instructors of pharmacy student training. Beginning in 2006, academic associations also certify pharmacists with specialized knowledge and skills in each practical field, similar to the Board of Pharmaceutical Specialties in the United States. Because of the changes brought about by these new systems, pharmacists must acquire more extensive clinical skills than learned in pharmacy school.

Previously, pharmacists in Japan did not examine patients directly. However, it is now acknowledged that pharmacists should monitor patient vital signs to evaluate drug treatment effects and adverse events. Monitoring patients’ vital signs is a fundamental activity for medical
personnel. The “Vision of Medical Security for Confidence and Hope,” developed by the Ministry of Health, Labour and Welfare, addresses the shortage of physicians in Japan, and an interim report identified skill mix (shared tasks that can be performed by nonphysicians acting as co-medicals) as one approach to alleviating the shortage. To provide efficient and safe medical care, pharmacists should be able to perform these patient services when providing pharmaceutical care.

To better equip pharmacy students with the skills they will need in practice in pharmacists’ new role as co-medicals (medical personnel), Kyushu University of Health and Welfare’s School of Pharmaceutical Sciences developed a program to train students to monitor patient vital signs to observe the effects of drugs and identify adverse events. The clinical pharmaceutical training program uses human patient simulators and includes instruction in bedside monitoring of drug administration, vital-sign monitoring, blood drawing, and training in emergency medical procedures. Because pharmacists are frequently present at emergency care sites, they should acquire the same basic emergency care techniques as medical personnel. Clinical training in resuscitation includes selecting the correct drugs and determining their dose and timing of administration, while monitoring the patient’s blood pressure, pulse, and arterial blood oxygen saturation (SpO2). We report an experience-based program in pharmacy schools that uses simulators to teach vital-sign monitoring. Training in vital sign monitoring was required of all third-year pharmacy students as part of the Bedside Training Practice.

DESIGN

Monitoring the Route of Drug Administration

In the initial bedside training, rectal, subcutaneous, and intramuscular drug administration was monitored, and simulated blood was drawn. To monitor the students’ skills/techniques and administering drugs, we used a commercial universal training model, Sakura (Kyoto Kagaku Co., Ltd., Kyoto, Japan), which had been modified for pharmaceutical use. The modifications allowed (1) insertion of gastric tubes into gastric and intestinal fistulae, (2) addition of organs, (3) easy insertion of suppositories, (4) application of bedsore pads, (5) easier delivery of subcutaneous, intramuscular, and intravenous injections and monitoring of central venous nutrition by providing a greater number of puncture sites. For simulation of subcutaneous and intramuscular injections and drawing of blood, a subcutaneous pad/attachable brachial muscle injection simulator, Limit (Kyoto Kagaku Co., Ltd., Kyoto, Japan), and venous blood injection simulator, Shinjo (Kyoto Kagaku Co., Ltd., Kyoto, Japan) were used (Figures 1 and 2).

Use of Vital-Sign Monitoring Devices and Simulators

During bedside training, techniques for measuring vital signs, including blood pressure, body temperature, pulse, and respiration, were taught using various vital-sign monitoring devices. The hemomanometers were a mercurial manometer (for auscultation of Korotkoff sounds) and an automatic manometer (with oscillometric arm band). Mercurial, electronic, ear, and instantaneous skin thermometers were used. A spirometer, peak flow meter, and vital capacity measurement device also were used. Detailed instructions on the use of the devices were provided by physicians from our university. Monitoring of blood pressure, pulse, and cardiac, respiratory, and intestinal sounds; electrocardiography; and examination of the pupillary reflex also were performed using a vital-sign simulator of heart
Examining Pathological Conditions Using Biological Simulators

An advanced cardiac life support trainer (HeartSim, Laerdal Co, Ltd, Stavanger, Norway, 2 models) and a high-performance patient simulator (adult model, ECS Stan, METI Co., Sarasota, FL), was used to simulate cardiopulmonary resuscitation after ventricular fibrillation (VF), with recovery by adrenaline and oxygen administration. The high-performance patient simulator responds to drug administration and ventilation based on clinical pharmacokinetic and pharmacodynamic data; the characteristics of diseases and disorders and changes in vital signs closely resemble those of humans. We edited our original ventricular fibrillation scenario (Table 1), and then programmed using software developed exclusively for the computer that accompanies the biological simulator (Table 2).

Use of Biological Simulators in the Preparation of Videos of Emergency Care Procedures

In the scenarios outlining the pathological conditions illustrated with the biological simulator, roles were assigned to physicians, nurses, and pharmacists so that the students could easily imagine performing the actions under the direction of an emergency team leader. We adopted drug treatment scenarios used in the advanced cardiac life support (ACLS) workshop sponsored by the Miyazaki Medical Association (Miyazaki, Japan), which were focused on accurate emergency care education (eg, a patient develops myocardial infarction and then ventricular fibrillation, and recovers after resuscitation and drug administration). The resuscitation method adhered to the American Heart Association’s 2005 guidelines. Instruments to facilitate treatment (defibrillator with a monitor and SpO2 measurement device), related devices (face shield, cardiopulmonary resuscitation [CPR] board, Magill forceps, Ambu mask, endotracheal tube, intubation tube fixing device, stylet, and tube holder), drugs (adrenaline [Epiquick injection, 0.1%], dopamine [Predopa injection, 600 mg, physiological saline injection], syringes, and needles were used.

EVALUATION AND ASSESSMENT

Before and after bedside training, 128 students were asked to complete a questionnaire to assess their understanding of vital sign monitoring and emergency care. The items assessed included: (1) route of drug administration (tubal nutrition, injection route), (2) administration...
technique (rectal administration to a patient), (3) subcutaneous and intramuscular injections, (4) blood drawing, (5) vital-sign measurement devices (hemomanometer, thermometer, etc), (6) spirometer/peak flowmeter and vital capacity measurement device, (7) the Ichiro vital-sign simulator for heart disease examination, (8) the Physico physical assessment model, (9) the HeartSim ACLS trainer, and (10) the Stan high-performance patient simulator. Training in vital sign monitoring was required of all third-year pharmacy students as part of the bedside training practice.

After reading each item on the questionnaire, students placed a mark on a visual analog scale with endpoints “do not understand at all” and “completely understand” to indicate their degree of understanding using a conversion scale. The length of the line drawn by the student was calculated as a percentage for each item. Differences in the level of understanding before and after training were analyzed using the Wilcoxon rank-sum test. Results are presented in Table 3.

DISCUSSION

Experience-based instruction in vital-sign monitoring was provided to pharmacy students using various human patient simulators, and as a result, student recognition of the necessity of vital-sign monitoring significantly increased. Although our findings are based on students’ self-assessments, we hope that an objective evaluation of student mastery of the techniques that comprise the training program can be conducted in the future.

In the posttraining self-assessment, the items that students understood best were (indescending order) vital-sign monitoring devices, monitoring route of drug administration, rectal drug administration, and the spirometer/peak flowmeter and vital capacity measurement device. In other words, understanding of items related to medical equipment and the pharmaceutical universal training model was high. Lower comprehension (in descending order) was reported for the vital-sign simulator of heart disease examination, Ichiro; blood drawing; the physical assessment model, Physico; subcutaneous and intramuscular injections; the
high-performance patient simulator, Stan; and the ACLS
trainer, HeartSim. Understanding of the items related to
the use of human patient simulators was low. However,
student understanding increased for all items (p < 0.01,
Table 1).

Regarding simulator-based education in other
schools, a medical school in Singapore reported that the
use of a patient simulator facilitated real-time visualization
of patients’ conditions, increased subsequent learning, and
depended student understanding for all items (p < 0.01,
Table 1).

Experience-based education in vital-sign monitoring
using simulators is essential for pharmacy students and
practicing pharmacists. Accordingly, it is necessary for
pharmacy schools to establish a continuing education sys-
tem to offer instruction to practicing pharmacists. We
hope to offer our scenarios via download from the Laerdal
Japan homepage; videos will be added later. Our experi-
ence suggests that pharmacy students are able to acquire
fundamental techniques through this educational method,
and to better understand their new role as members of a
medical team.

SUMMARY
An experience-based education program to instruct
pharmacy students in monitoring vital signs to identify
drug treatment effects and adverse events was developed.
Medical emergency care programs using simulators were
prepared and used to facilitate clinical training in resusci-
tation, which required students to select drugs while mon-
toring changes in blood pressure, pulse, and arterial blood
oxygen saturation. As a result, there was a significant in-
crease in students’ understanding of vital-sign monitoring.
Experience-based education in vital-sign monitoring using
simulators is essential for pharmacy students and practic-
ing pharmacists.

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Table 3. Pharmacy Students’ Self-Assessment of Their Knowledge of Monitoring Vital Signs to Identify Drug Treatment Effects and Adverse Events After Completing a Training Session Using Simulators, N=128

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Understanding (%)a,b</th>
<th>Preintervention</th>
<th>Postintervention</th>
</tr>
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<tbody>
<tr>
<td>Checking and experience of various routes of administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tubal nutrition and injection routes</td>
<td>30</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Rectal administration to a patient</td>
<td>21</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Subcutaneous and intramuscular injections</td>
<td>28</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Blood sampling</td>
<td>22</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Use of the following to perform vital sign checking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vital sign-related devices (hemomanometer, thermometer, others)</td>
<td>37</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Spirometer/peak flowmeter and vital capacity measurement device</td>
<td>20</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Vital sign simulator for heart disease examination, Ichiro</td>
<td>11</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Physical assessment model, Physico</td>
<td>11</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Checking of pathological conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACLS trainer, HeartSim</td>
<td>12</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>High-performance patient simulator, Stan</td>
<td>11</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

a Percentages based on students’ responses using a visual analogue scale with endpoints “do not understand at all” and “completely understand” to indicate their degree of understanding.
b Comparisons for all items showed students’ understanding significantly improved after undergoing training using simulators, p < 0.01 (Wilcoxon rank-sum test).
We are grateful to Satoshi Jyojyo, Clinical Engineer of IMI. Co., Ltd. for his cooperation in preparing the video materials for this program.

REFERENCES