Changes in objectively assessed chest compression quality after a basic life support course: the fourth report

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Objective: It was aimed to research changes in the quality of CPR directly following a BLS course and 2 years later by using the objective evaluation function targeting nurses working at hospital wards with little experience in CPR. Materials and Methods: Among 34 nurses who took the BLS course, 5 people who continued to cooperate in the research were examined as subjects, and their quality of CPR of right after the BLS course as well as 2 years later was assessed by using the objective evaluation function. Results: When compared between immediately after and 2 years after the BLS course, “CCF” increased from 63.4 ± 3.29% to 68.2 ± 2.28% (p<0.05). The “average ventilation volume” increased from 408.6 ± 107.9 ml to 636.8 ± 198.2 ml (p<0.05). The “ventilation frequency” increased from 7.2 times to 9.8 times (p<0.05).

Discussion: Even a nurse with little CPR experience was considered to have had an opportunity to reacquire the necessary knowledge and skills through the clinical ladders within the facility and the training related to CPR inside and outside the hospital, which positively affected the quality of CPR.

1. Introduction
High-quality cardiopulmonary resuscitation (hereinafter referred to as “CPR”) has become an important element of treatment in the sense that it promotes early return of spontaneous circulation while maintaining the blood flow of vital organs. According to the American Heart Association (hereinafter referred to as “AHA”)¹¹ and the Japan Resuscitation Council (hereinafter referred to as “JRC”)², a possibility of survival of the sick or injured can be increased by the high-quality CPR.

Although the guideline has been widely established and CPR courses are held in and out of medical facilities, there were few studies that objectively investigated the assessment of the quality of CPR after taking the courses³, and many were evaluated by checking the evaluation tables⁴-⁶ as well as the videotaped procedures⁷-⁹. In addition, no post-course survey has been conducted after 2 years of attending since surveys are conducted before and after the course³,⁷-⁹, monthly until 3 months after attending⁶, and 1.5 years after the course¹⁰. The AHA recommends taking the course every 2 years to maintain BLS skills; however, by clarifying changes in the quality of CPR between

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ABSTRACT
OBJECTIVE
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MATERIALS AND METHODS
Among 34 nurses who took the BLS course, 5 people who continued to cooperate in the research were examined as subjects, and their quality of CPR of right after the BLS course as well as 2 years later was assessed by using the objective evaluation function.

RESULTS
When compared between immediately after and 2 years after the BLS course, “CCF” increased from 63.4 ± 3.29% to 68.2 ± 2.28% (p<0.05). The “average ventilation volume” increased from 408.6 ± 107.9 ml to 636.8 ± 198.2 ml (p<0.05). The “ventilation frequency” increased from 7.2 times to 9.8 times (p<0.05).

DISCUSSION
Even a nurse with little CPR experience was considered to have had an opportunity to reacquire the necessary knowledge and skills through the clinical ladders within the facility and the training related to CPR inside and outside the hospital, which positively affected the quality of CPR.
directly after the BLS course and 2 years later, the results can be reflected to the positioning of the BLS course and the way of education within medical facilities.

From the above, the change in the quality of CPR between immediately and 2 years after participating in a BLS course was clarified by using the objective evaluation function.

**Objective**

The objective was to research the transition of the quality of CPR immediately following a BLS course and 2 years later by using the objective evaluation function targeting nurses working in hospital wards with little experience in CPR.

**2.Materials and Methods**

1) **Subjects**

5 subjects cooperated in the continuous research among 34 nurses who participated in the BLS courses held at Yokohama ACLS between June and November of 2014.

2) **Research Period**

From October 2016 to December 2016, which was 2 years after taking the BLS course.

3) **Research Method**

We investigated the quality of CPR immediately after the course and 2 years later by using a training manikin that can objectively assess performance of individual’s CPR skill (Laerdal Medical’s Resusci Anne with QCPR®). The assessment was carried out focusing on the following research items: “Overall performance (%),” “Correct hand position,” “Chest compression frequency,” “Average depth of chest compression,” “Recoil,” “Correct compression depth,” “100-120 compressions per minute,” “Average chest compression frequency,” “Ventilation frequency,” and “Average ventilation volume.” Collected data were analyzed using a Wilcoxon signed-rank test, considering a P-value<0.05 to indicate statistical significance. Further, these data were collected without feedback on the quality of CPR before and after the assessment.

4) **Ethical Consideration**

After obtaining the approval from the Ethics Committee, the purpose of the research was explained to the research participants orally as well as in writing. They agreed to participate by answering the questionnaire. In consideration of protecting the privacy of the research participants, their personal information was coded so that they could not be identified.

**3.Results**

1) **Overview of Participants**

There were 5 research participants. Their years of experience are 3-11 years, and the average years of experience was 7.0 years (± 4.0). All subjects had CPR training within or outside of the medical facilities prior to the BLS course. 4 subjects were first-time attendees, and 1 subject was for retraining. All subjects worked in the area of an emergency room or an intensive care unit. 2 subjects had CPR experience before the course, and 2 subjects had CPR experience after the course. 2 subjects had no CPR experience. Every subject had participated in some training related to CPR within 2 years after taking the BLS course (Table 1).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>Nursing experience</th>
<th>Emergency / intensive care experience</th>
<th>CPR experience Before the course</th>
<th>Number of participants in CPR class Before the course</th>
<th>After the course</th>
<th>CPR experience After the course</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Female</td>
<td>30</td>
<td>12</td>
<td>no</td>
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</table>

Table 1. Overview of subjects
BLS was included in the items pertaining to responses to sudden changes in clinical ladders in their affiliated facilities.

2) Changes in the Quality of CPR Immediately After Taking the BLS Course and 2 Years Later

A significant difference was found in "CCF," "average ventilation volume" and "ventilation frequency" between immediately after the BLS course and 2 years later. "CCF" increased from 63.4 ± 3.29% to 68.2 ± 2.28% (p<0.05) (Figure 1), and "average ventilation volume" increased from 408.6 ± 107.9 ml to 636.8 ± 198.2 ml (p<0.05) (Figure 2). "Ventilation frequency" increased from 7.2 ± 1.79 times to 9.8 ± 0.45 times (p<0.05) (Figure 3). Although there was no significant difference in other items, the following changes showed that the average value of 2 years after the course increased and became in the range of baseline compared to the average taken directly after the course. "Overall performance" 69.6% to 79.2%, "Average depth of chest compressive" 49.2 mm to 51.4 mm, "correct hand position" 80% to 100%, and "Average chest compression frequency" 121.8/min to 119.6/min (Table 2).

### Table 2. Items within the standard value or rising in 2 years after attendance

<table>
<thead>
<tr>
<th></th>
<th>Overall performance (%)</th>
<th>Average depth of compressions (mm)</th>
<th>Proper hand positioning (%)</th>
<th>Average number of compressions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediately after the course</td>
<td>69.6</td>
<td>49.2</td>
<td>80</td>
<td>121.8</td>
</tr>
<tr>
<td>2 years after the course</td>
<td>79.2</td>
<td>51.4</td>
<td>100</td>
<td>119.6</td>
</tr>
</tbody>
</table>

### Fig.1 Change in CCF immediately after attendance and two years after

### Fig.2 Change in average ventilation volume immediately after attendance and two years after

### Fig.3 Change in the number of ventilation volume immediately after attendance and two years after

## 4. Discussion

A way to maintain skills after taking a BLS course is left up to each individual. It has been revealed by evidence that knowledge rapidly declines after initial training\(^1\). For this reason, the AHA recommends taking the BLS course again within two years after attending the BLS course\(^2\). The subjects of this study had undergone basic training and CPR training in medical facilities before participating in the BLS course; therefore, it was not their first first-aid training although they had never taken a BLS course before. However, there was no major change in the quality of CPR immediately and 2 years after the course, while working in a ward where CPR is not frequently performed. In addition, the values of "CCF," "average ventilation volume," and "ventilation frequency" were higher for
2 years later than immediately after. Although this research is on 1-rescuer method, higher “CCF” is an important factor to improve the quality of CPR. In the AHA guideline 2015, as before, to minimize the length of interruptions of chest compressions is emphasized. The increased values of items related to mouth-to-mouth ventilations are deemed to have influenced the rise in “CCF” in 1-rescuer method. From these results, it seems to be necessary to investigate how it will affect in the case of 2-rescuer method in the future.

Furthermore, it was found that the reason why the subjects without much CPR experience were able to maintain the quality of CPR was that they participated in CPR training classes multiple times after taking the BLS course. From the above, it seems that motivation to maintain skills after taking the BLS course has a great influence on maintaining skills afterwards. According to one theory about the nurses’ psychological aspects pertaining to CPR outside of emergency and intensive care unit areas, nurses conduct their daily practice while worrying about when they will encounter a case of cardiopulmonary resuscitation. It is also said that a key for nurses who rarely encounter a scene of cardiopulmonary resuscitation to execute cardiopulmonary resuscitation assertively is to remove their anxiety. In addition, specific actions to prepare themselves for sudden changes are said to be individualized depending on experiences, knowledge of disease condition, support from surrounding people, and environment. To support this rationale, the results of the previous studies conducted by the authors indicated the increased quality of chest compressions 6 months after taking the BLS course compared to immediately after. As its background, it can be considered that the quality of CPR has been influenced by the motivation to take the BLS course and opportunities to update the required knowledge and skills for CPR through classes held within and outside of hospitals after attending the BLS course since the BLS course is included as a requirement in the adopted clinical ladders at the subjects’ facilities.

By assessing the quality of CPR with the objective evaluation function in this research, quantification of skills of CPR was made possible. The AHA guideline 2015 explains the need for utilizing audio-visual feedback devices that monitor and record the quality of CPR in real time. It can not only assess the skills clearly but also be used as a feedback device in the CPR training. These have revealed that the device is useful as an effective educational tool when utilized in maintaining and improving the quality of CPR.

In the future, it is necessary to unveil some specific approaches to the changes and retention of the quality of CPR of the continuing research subjects. In addition, effective intervals between the courses to maintain the quality of CPR should be examined by clarifying the effective educational support system since it can also influence the quality of CPR.

5. Conclusions
1) Unlike former reported results, items related to chest compressions did not show any significant decrease in quality when the results of directly after the course and 2 years later were compared. Further, the quality of CCF, ventilation frequency, and ventilation volume increased after 2 years than immediately after the course.
2) It was an opportunity to reacquire knowledge and skills through the clinical ladders in the facilities and the training related to CPR inside and outside the hospital.
3) It became clear that the objective evaluation function is useful for grasping the transition of CPR skills over time.

References
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客観的評価機能を用いたBLSコース受講後の胸骨圧迫の質の推移について（第4報）

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【目的】CPRの経験が少ない病棟所属の看護師を対象に、客観的評価機能を用いてBLSコース受講直後と2年後のCPRの質の推移について調査することを目的とした。

【方法】BLSコースを受講した看護師34名中、継続して調査協力が得られた5名を対象として、BLSコース受講直後と2年後に客観的評価機能を用いてCPRの質を調査した。

【結果】BLSコース受講直後と2年後で「CCF」は63.4%から68.2%(p<0.05)に上昇した。「平均換気」は408mlから636ml(p<0.05)に増加した。「換気回数」が7.2回から9.8回(p<0.05)に増加した。

【考察】CPRの経験が少ない看護師でも、施設内のクリニカルラダーの存在、院内外のCPRに関連する講習を通じて、必要な知識と技術の再習得の機会になり、CPRの質に影響していたと考えられた。

キーワード：BLS, 看護師, CPR質の推移

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