Dear Editor:

Predicting clinical deterioration in inpatients is a challenging but essential problem for clinicians. The rapid response system (RRS) has been introduced to identify such patients before deterioration and provide early intervention to prevent fatal outcomes [1]. Although the beneficial impact of RRS on clinical outcomes may be controversial, some studies have demonstrated that RRS can reduce the rates of unexpected hospital deaths and cardiac arrest. Although the RRS can reduce the risk of unexpected deterioration, this requires substantial manpower. Therefore, to improve the efficiency of the RRS, an early warning score (EWS) is commonly used, which is a scoring system to help recognize inpatients with a potential for acute deterioration [2,3]. An ideal EWS with high sensitivity and specificity can reduce the workload of the physician in detecting clinical deterioration. To understand the relationship between the RRS and EWS, we used a questionnaire survey to investigate the subjective efficacy and shortcomings of the RRS and EWS based on the perception of critical care physicians (Supplementary Material 1).

Our study included board certified critical care physicians registered as members of the Korean Society of Critical Care Medicine, working at 45 tertiary general hospitals or central public community hospitals. A link to the online self-questionnaire was distributed to potential participants via e-mail from July 13, 2021, to July 28, 2021. In total, 116 of 407 respondents (28.5%) completed the survey and were included in the analysis. Among the total respondents, 62 (53.4%) were specialists in internal medicine, 91 (78.4%) were critical care subspecialists, and 69 (59.5%) were employed at tertiary general hospitals. Fifty-six respondents (48.3%) worked at RRS operating centers, defined as institutions with a pilot assessment project of RRS operated by the Ministry of Health and Welfare, and 50 respondents (43.1%) utilized an EWS. These respondents estimated a mortality reduction of 23.9% and a reduction in severe deterioration of 32.9% by operating RRS. Although the perceived increase in workload was 20.0%, the respondents believed that the reward for operating RRS was 41.8% less than their expectations as a result of the increased workload (Table 1). Moreover, although an adequate number of well-trained clinicians and reasonable rewards are required to operate a qualified RRS, respondents considered both to be insufficient compared to personal expectations. Adequate manpower replenishment and additional financial support are essential to promote the use of the RRS nationally according to these results. Regarding the important
requirements needed to operate an ideal RRS, respondents thought (1) multidisciplinary cooperation with other depart-
ments (33.0%), (2) appropriate reward (27.7%), (3) efficient management of human resource (15.2%), and (4) introduction of a better EWS (12.5%) were needed. It is interesting that multidisciplinary cooperation was the most-needed factor, implying that RRS requires a systematic support of various medical backgrounds.

The mean value for the perceived accuracy in detecting deterioration in patients was 65.6% for physicians using the current generation of the EWS, which was similar to the mean value in those who did not use the EWS (65.9%, P=0.97). It is interesting that there was no difference between the perceived

### Table 1. Change of clinical outcomes and workload and reward of medical staff after starting RRS

| Variable                              | RRS (n=56) |
|---------------------------------------|------------|
| Mortality (mean, %)                   | –23.9      |
| Severe deterioration (mean, %)        | –32.9      |
| Workload of medical staff (mean, %)   | 20.0       |
| Reward of medical staff (mean, %)     | –41.8      |

RRS: rapid response system.

![Figure 1. Developing better early warning score (EWS). (A) The biggest problem with EWS currently in use. (B) Items that must be added other than vital sign. LAB: laboratory findings including ABGA; ABGA: arterial blood gas analysis.](image)

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accuracy of EWS and that based on individual vital signs. This implies respondents recognized that the clinical judgement by on-duty clinicians with individual vital signs are similar to an automatically calculated EWS. Therefore, using the EWS could reduce the workload of clinicians.

The perceived shortcomings of the current EWS were (1) unnecessary efforts due to inaccurate alarms (false positives, 44%), (2) neglecting acute deterioration due to inaccurate alarms (false negatives, 18%), (3) patient characteristics and disease entities not suitable for applying the EWS (18%), and (4) difficulty in incorporating various variables into the EWS (14%) (Figure 1A). These values showed that the false-positive rate was perceived as the largest hurdle in successfully adapting EWS. The median acceptable value of the false-positive/true-positive ratio by the respondents was 2.5 (interquartile range, 1.5–3.0). Regardless of how well the EWS detects early exacerbation, if the false-positive rate is high, the RRS team will be worn out.

We asked respondents how effective an ideal EWS would be, and they estimated that a more accurate EWS could reduce adverse events by 43.2%. Considering these results, there would be sufficient demand for a better EWS if the abovementioned shortcomings were improved. Since the false-positive rate was selected as the largest weakness, this should be considered when developing a new-generation EWS. In addition, to develop a better EWS, respondents thought that the top three items that must be added other than vital signs were mental status (34.2%), oxygen demand (25.4%), and arterial blood gas findings (24.6%) (Figure 1B); the top three events that require early detection were respiratory failure (38.5%), sepsis (29.9%), and cardiac arrest (22.9%).

This study had several limitations. First, because of the nature of the questionnaire survey study, we could not determine how much the RRS and EWS improved patient outcomes. However, we intended to investigate the perception of the RRS and EWS of critical care physicians, which could not be obtained in studies such as randomized controlled trials. Second, although differences may exist in the perceived benefits for the RRS and EWS depending on the size of the hospitals where respondents work, our study enrolled multiple participants from the same hospitals. In the current survey analysis, physicians thought that the RRS and EWS could prevent adverse events in hospitals, and that there was room to develop a more accurate EWS, which they believed would effectively improve patient outcomes.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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ORCID

Sang-Hyeon Park https://orcid.org/0000-0001-8453-4146
Jeehoon Kang https://orcid.org/0000-0002-9078-2231
Tae Jung Kim https://orcid.org/0000-0003-3616-5627
Hong Yeul Lee https://orcid.org/0000-0002-3638-8890
Hyun-Jai Cho https://orcid.org/0000-0002-2779-4037
Sang-Min Lee https://orcid.org/0000-0002-1388-9318

AUTHOR CONTRIBUTIONS

Conceptualization: JK. Data curation: SHP. Formal analysis: SHP. Methodology: TJK, HYL, HJC, SML. Project administration: JK. Visualization: SHP. Writing–original draft: SHP. Writing–review & editing: JK.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via https://doi.org/10.4266/acc.2022.01144.

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