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## Short paper

# Content validation of the HeartRunner questionnaire to volunteer responders dispatched to out-of-hospital cardiac arrests: A qualitative study



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### Abstract

**Aim:** To increase survival after out-of-hospital cardiac arrest (OHCA) in Denmark, volunteer responders are activated through a smartphone application (HeartRunner app) to quickly locate an automated external defibrillator (AED) and assist with cardiopulmonary resuscitation (CPR). All dispatched volunteer responders who have been activated by the app receive a follow-up questionnaire to evaluate their participation in the programme. The content of the questionnaire has never been thoroughly evaluated. We therefore aimed to validate the content of the questionnaire.

**Methods:** Content validity was evaluated qualitatively. It was based on individual interviews with three experts, along with three focus group interviews and five individual interviews using cognitive interview technique, with a total of 19 volunteer responders. The interviews were also used to inform refinements of the questionnaire to reach improvements in content validity.

**Results:** The initial questionnaire consisted of 23 items. After the content validation process, the questionnaire consisted of 32 items; with the addition of 9 new items. Specifically, some original items were merged into one item or divided into separate items. Moreover, we revised the order of items, some sentences were rephrased or reworded, an introduction and headlines to different sections were added, and skip logic were incorporated to hide non-relevant items.

**Conclusion:** Our findings support the importance of validating questionnaires to ensure accuracy of survey instruments. Validation led to modifications of the questionnaire, and we propose a new version of the HeartRunner questionnaire. Our findings support the content validity of the final HeartRunner questionnaire. The questionnaire may allow the collection of quality data to evaluate and improve volunteer responder programmes.

**Keywords:** Questionnaire validation, Content validity, App, Cardiopulmonary resuscitation, Citizen responders, Out-of-hospital cardiac arrest

## Introduction

Early cardiopulmonary resuscitation (CPR) and defibrillation are paramount to maximize chances of survival from out-of-hospital cardiac arrest (OHCA).<sup>1,2</sup> Activating nearby volunteer citizens in case of a cardiac arrest has the potential to increase bystander CPR and defibrillation in both public and residential locations.<sup>3,4</sup> Alerting volun-

teer citizens by text-messages or smartphone applications (apps) has become widespread worldwide, but little is known about how and when volunteer responder systems work most effectively and importantly, how volunteer responders perceive and are affected by the incident.<sup>5</sup> In September 2017, a volunteer responder system using the HeartRunner app to activate volunteer responders was implemented in the Capital Region of Denmark.<sup>5</sup> Since then, the programme has become nationwide, and at present, more than 150,000

*Abbreviations:* AED, Automated external defibrillator, CPR, Cardiopulmonary resuscitation, EMS, Emergency Medical Services, OHCA, Out-of-hospital cardiac arrest

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volunteers have signed up. All volunteer responders who have been alerted through the app receive an electronic questionnaire about 90 minutes after the alarm. The aim of the questionnaire is to investigate how and when the programme works most effectively and how volunteer responders perceive and are affected by the incident. It explores if and how the citizens arrived at the cardiac arrest location, if they arrived before the emergency medical services (EMS), and if they brought a defibrillator. Furthermore, the questionnaire consists of items related to the resuscitation attempt and the psychological and physical impact of the incident. The questionnaire was translated from a Swedish questionnaire with 16 items (survey version 1)<sup>3</sup> and adapted to consist of 23 items (survey version 2) but has never been thoroughly evaluated (survey version 2 are available in [Appendix A1](#)). High content validity of the questionnaire is important to properly evaluate the system. Content validity can be defined as the ability of the selected items to reflect the features of the construct in the measure.<sup>6</sup> For example, whether the questionnaire covers all relevant topics. Further, content validity can also provide information on the clarity of items. The questionnaire can be improved through achieving information from representatives of the target group and experts.<sup>7</sup> The aim of this study was to assess and optimize the content validity of the HeartRunner questionnaire to dispatched volunteer responders in Denmark.

## Methods

The content validation of survey version 2 was carried out in four steps. Steps 1, 2 and 3 were set out a priori. Step 1 involved interviews with experts. Besides the value of the individual expertise with the topic to be studied, this step also had the purpose to generate new themes to be used in the interview guide for the focus groups in step 2. Changes were made to the questionnaire after step 2 and these changes were tested in cognitive interviews in step 3. Due to the fairly big number of further changes made to the questionnaire based on step 3, we decided to recruit more volunteer responders to test the revised questionnaire in step 4. The four-step process will be described in more details in the following:

In step 1, the questionnaire was evaluated through individual interviews with two experts with knowledge within the Danish volunteer responder system, and cardiac arrest research followed by one interview with a third expert with experience within the field of trauma and psychology. The two experts within the Danish volunteer responder system were identified from the Danish volunteer responder research group and selected based on their specific knowledge and experience from managing the volunteer responder program. The expert within trauma and psychology was specifically approached and selected based on his extensive knowledge of stress, trauma, and crisis.

In step 2, the questionnaire was discussed in two focus groups with volunteer responders. In order to increase participants propensity to open up about a topic, we grouped participants with similar age in the same focus group, thus four volunteer responders aged 20–29 years old in one group, and five 40–63 years old in the other group. All the participants had recently received an alarm on the HeartRunner app. The primary purpose of the focus groups was to examine whether some important aspects or dimensions were missing from the questionnaire. In addition, the participants were asked about the clarity and the order of the items as well as the structure of the questionnaire. The interactive nature of the focus group

allowed the participants to expand their contributions to the discussion in the light of points raised by other participants.<sup>8</sup>

In step 3, the subsequent version of the questionnaire was pre-tested by four volunteer responders. In this step, we assessed participants' perceptions and acceptability of the questionnaire. The interviewer relied on cognitive interviewing techniques.<sup>9</sup> To avoid unknowingly influencing answers in a particular direction, each interview started with a think-aloud approach, meaning that the participants were encouraged to articulate their thoughts while answering the questions. This approach was supplemented with the verbal probing method, where the interviewer followed up by asking for other, specific information relevant to the question or to the specific answer given by the participants.<sup>9</sup> Based on the focus groups and cognitive interviews the research team created a revised version of the questionnaire.

In step 4, the revised version of the questionnaire was subsequently tested by six volunteer responders. Five of the volunteer responders were interviewed in a focus group setting, and one interview was carried out as an individual interview. In this step, each item in the revised version of the questionnaire was carefully reviewed in order to ensure volunteer responders' understanding and acceptability of the item.

The selection of volunteer responders was based on maximum variation sampling to capture a wide range of responders' perspectives.<sup>10</sup> They were recruited from the volunteer responder database and initially invited to take part in the study through email. Thirty-two volunteer responders, all of whom had received an alarm on the HeartRunner app within the past week, were invited to participate. All participants gave written informed consent to participate. The interviews were conducted online and lasted approximately 1-1½ hour. They were all recorded, and summaries were made and analyzed based on systematic text condensation where the informants' statements were summarized into shorter statements.<sup>11</sup> The main meaning of what has been said has thus been reformulated in a few words. In addition to the above interviews, the questionnaire was evaluated by researchers with expertise in mental health, questionnaire development, experience with the HeartRunner app as well as proofreading and grammar. A researcher with expertise in mental health contributed to the validation of the items concerning psychological impact after an event to ensure the questions are up to best practice. Researchers with expertise within questionnaire development were asked to review draft questionnaires to identify questionnaire problems and contributed to construction of new items and amended the composition and order of items. We also gathered inspiration from already developed and validated items and response options, such as Likert scales.<sup>12</sup>

The Danish HeartRunner Trial (NCT03835403) was assessed by the local ethics committee and accepted without the need for further approval (Journal nr.: 17018804).

## Results

### Participants

The participants of the study included three experts and nineteen volunteer responders. The sample of volunteer responders covered men and women, different age groups, professions, years since the last first aid course, the number of times they received an alarm on the HeartRunner app and participants from all five regions in Denmark ([Table 1](#)). [Table 1](#) shows the characteristics of the participating volunteer responders.

**Table 1 – Characteristics of the nineteen volunteer responders who participated in the study.**

	N (%)
<b>Profession</b>	
Healthcare	5 (26)
Police	4 (21)
Other	10 (53)
<b>First aid course</b>	
>2 years ago	5 (26)
1–2 years ago	5 (26)
<1 year ago	9 (48)
<b>Sex</b>	
Woman	6 (32)
Man	13 (68)
<b>Age</b>	
20–29 years old	6 (32)
30–44 years old	7 (36)
45–63 years old	6 (32)

### **Themes identified in the process of content validation and further development of the questionnaire**

Different themes emerged based on interviews with volunteer responders and experts. Almost all participants expressed clarity or comprehension problems with some items in the initial questionnaire (survey version 2). Some words or concepts or the entire question were worded in a way that caused different interpretations of the same item or difficulties in understanding. Participants also expressed problems with many of the item's response options. For example, participants stated that the item about reaching the patient with cardiac arrest (Q8 in survey version 2) had inadequate response options for them to provide an accurate answer. Many participants did not reach the cardiac arrest patient, but for other reasons than those stated in the response options, giving them no response option to fit their experience. Other themes that emerged from the interviews were lack of information about the purpose of the questionnaire, the order of the items, the composition of items and the extent to which the set of items comprehensively covers the components wished to be measured. Based on the themes identified, several changes were made to the questionnaire. Overall themes and changes are shown in [Table 2](#). The initial Danish questionnaire (survey version 2) and the final version of the questionnaire based on the changes (survey version 3) are available in [Appendix A1 and A2](#) and have gone through a professional translation to English.

## **Discussion**

This study provides a comprehensive content validation of the HeartRunner questionnaire, based on qualitative methods. After the content validation, several changes were made to the questionnaire, including the addition of nine items. The final version of the questionnaire (see survey version 3 in [Appendix A2](#)) now also explores the user experience with the app, cooperation with the other volunteer responders and the emergency medical services, whether responders experienced the incident as very stressful or chaotic, and specific circumstances around the incident, that could affect them psychologically. The questionnaire can be used for the collection of data to evaluate and improve similar programmes activating volunteer responders to OHCA. To date, no validated questionnaires for evaluating

volunteer responder systems are available, thus, this study contributes to relevant items to include in surveys for this population.

We managed to obtain a representative group of volunteer responders. However, it cannot be ruled out that inclusion of more participants could have contributed with further understanding. We recognize that evaluating psychological impact immediately after a potentially traumatic event is complex. Thus, the single item measuring this concept may not capture all aspects. Nevertheless, to our knowledge no relevant validated item or scales are available. Existing validated scales such as the Impact of Event Scale, the Clinical administered PTSD Scale, or the Perceived Stress Scale are constructed to measure long-term impact, symptoms of post-traumatic stress disorder, or nonspecific stress rather than immediate impact.<sup>13</sup>

## **Conclusion**

This study assessed the content validity of the HeartRunner questionnaire and identified some points of confusion, unclear directions, questions difficult to answer and topics lacking which led to a revised version of the questionnaire. A content validated HeartRunner questionnaire to evaluate citizen responder programmes is now available. This may allow the collection of quality data to evaluate and improve such programmes.

## **Conflicts of interest**

None declared.

## **CRediT authorship contribution statement**

**Louise Ayoe Sparvath Brautsch:** Methodology, Investigation, Data curation, Writing – original draft. **Line Zinckernagel:** Methodology, Supervision, Writing – review & editing. **Astrid Marie Rolin Kragh:** Conceptualization, Resources, Writing – review & editing. **Carolina Malta Hansen:** Conceptualization, Writing – review & editing. **Astrid Lykke Storgaard Kristensen:** Investigation, Writing – review & editing. **Susan Andersen:** Methodology, Writing – review & editing.

**Table 2 – Changes made to the HeartRunner questionnaire based on themes identified in the process of content validation.**

Themes	Context	Changes made to the questionnaire	Examples on changes
Purpose of questionnaire	Some participants stated a lack of information about the purpose of the questionnaire. One expert reported that it is important to clarify the purpose and emphasized that all responses are important regardless of whether volunteer responders accepted the alarm or not.	A text message (SMS) and introduction were added.	
Item order and relevance	Misunderstandings appeared due to items not being asked in a logical order.	The order of items were restructured.	For example, the item concerning whether the volunteer responders reached the person with cardiac arrest (Q6 in survey version 2) were moved to the beginning of survey version 3 (Q2).
	Some leaps from one item to another caused confusion.	Five headlines were added to different sections.	Headline 1: When you got to the person with a cardiac arrest Headline 2: The circumstances surrounding the cardiac arrest/the event Headline 3: Personal consequences for you Headline 4: Your experience with the app Headline 5: Closing questions
	Participants experienced that some items were irrelevant for them and their experience.	Skip logic (activations) were added linking certain response options to specific items.	For example, if the volunteer responders replied not doing CPR and mouth-to-mouth (Q14 in survey version 3), the item concerning whether they initiated it (Q15 in survey version 3) is skipped.
Clarity / comprehension	Most participants expressed clarity or comprehension problems with some terms used. This caused different interpretations of the same item or difficulties in understanding. For example, the item “Had cardiopulmonary resuscitation (cardiac massage) been initiated when you arrived?” (Q9 in survey version 2) was by many volunteer responders understood as only cardiac massage, while the aim of the item was to capture if cardiac massage and/or artificial respiration had been initiated. Participants expressed that some words sent a wrong signal, for example the original item “Did you succeed in reaching the victim?” (Q6 in survey version 2) signals that volunteer responders failed if they didn’t reach the victim.	Sentences were rephrased or reworded.	For example, the term “cardiopulmonary resuscitation” was replaced by the term “CPR and/or mouth to mouth” in several items (Q11-Q16 in survey version 3).
Inadequate response options	Many participants expressed that some items did not have enough response options for them to provide an accurate answer. Especially, there were a lack of “do not know” responses.	Response options were added.	For example, in Q31 in survey version 3 “Why did you reject the alert?”, the following response option was added “Other reason(s). Please specify: (Free text box)”
	Participants stated that some response options caused misunderstandings. For example, the volunteer responders didn’t understand what the following response option covered “The defibrillator was not accessible” (a response option to the item “Why did you not succeed in retrieving a defibrillator?” (Q3 in survey version 2))	Response options were rephrased or reworded.	For example, the response option “The defibrillator was not accessible” was changed to “The AED was locked away” in Q9 in survey version 3.

**Table 2 (continued)**

Themes	Context	Changes made to the questionnaire	Examples on changes
Content coverage	Both experts and volunteer responders described that the questionnaire could advantageously add more items to capture more circumstances around the incident, including the user experience with the app, cooperation with the other volunteer responders and the emergency medical services, if the volunteer responders experienced the incident as very stressful or chaotic and specific circumstances around the incident, that could affect them psychologically.	9 new items and free text fields were added.	Survey version 3 now also explores the user experience with the app (Q28-Q29), cooperation with the other volunteer responders and the emergency medical services (Q23-Q24), and specific circumstances around the incident, that could cause a psychological response (Q18-Q22).
The composition of items	<p>Participants experienced that some items were difficult to answer because the items ask about more than one thing at a time. For example, in the following question, it is not possible for the citizens to state that there are severely affected by the experience, without also consider whether they need follow-up:            “What psychological impact did the experience have on you?            1) I was not affected            2) Mildly affected            3) Moderately affected            4) Severely affected, but no need for follow-up by healthcare personnel            5) Severely affected, with need for follow-up by healthcare personnel”</p> <p>A citizen described that she had ticked the response option number five, not because she was severely affected, but because she wanted a follow-up.</p> <p>On the other hand, some participants felt that some items were hard to distinguish from each other and almost asked the same thing.</p>	<p>Some items were divided into two separate items.</p> <p>Some items were merged into one item.</p>	<p>For example, the item Q18 in survey version 2 were divided into Q26 and Q27 in survey version 3.</p> <p>For example, Q12, Q14 and Q15 in survey version 2 were merged into one battery item in survey version 3 (Q14).</p>
Timing of data collection	The experts expressed the importance of asking about psychological impact (Q18 in survey version 2) close to the event for ethical reasons, as well as the need for the other items being asked close to the event, so it is fresh in memory. Thus, all volunteer responders who have been alerted through the app receives the questionnaire about 90 minutes after the alarm. However, the experts and volunteer responders all stated that it would make sense to receive the item about the psychological impact after some days has passed. An expert in the field argued that right after a traumatic event, people are in a kind of shock state where you cannot feel your emotions well, so it would be appropriate to follow-up.	The volunteer responders receive a new questionnaire with the same items concerning their mental state (Q26 and Q27 in survey version 3) three days after the alarm.	

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.resplu.2023.100378>.

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