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# Effects of a geriatric education program for emergency physicians: a mixed-methods study

Gijs Hesselink<sup>1,2</sup>, Özcan Sir<sup>1\*</sup>, Ekin Öztürk<sup>3</sup>, Nikki Heiwegen<sup>1</sup>,  
Marcel Olde Rikkert<sup>4</sup> and Yvonne Schoon<sup>1,4,5</sup>

<sup>1</sup>Department of Emergency Medicine, Radboud University Medical Center, Nijmegen, The Netherlands, <sup>2</sup>Radboud Institute for Health Sciences, IQ Health Care, Nijmegen, The Netherlands, <sup>3</sup>Department of Surgery, Radboud University Medical Center, Nijmegen, The Netherlands, <sup>4</sup>Department of Geriatrics, Radboud University Medical Center, Nijmegen, The Netherlands and <sup>5</sup>Radboud Institute for Health Sciences, Radboud University Medical Center, Nijmegen, The Netherlands

\*Correspondence to: Ö. Sir. E-mail: ozcan.sir@radboudumc.nl

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## Abstract

Emergency physicians (EPs) often regard care for older adults as complex, while they lack sufficient geriatric skills. This study evaluates the effect of a geriatric education program on EPs' geriatric knowledge, attitude and medical practice when treating older adults. A mixed-methods study was performed on EPs from two Dutch hospitals. Effects were measured by pre-post tests of EPs' ( $n = 21$ ) knowledge of geriatric syndromes and attitudes toward older adults, and by a retrospective pre-post analysis of 100 records of patients aged 70 years or more. Six EPs were purposively sampled and interviewed after completion of the education program. The program significantly improved EPs' geriatric knowledge. EPs indicated that the program improved their ability and attentiveness to recognize frailty and geriatric syndromes. The program also significantly improved EPs' attention for the older patient's social history and circumstances ( $P = 0.04$ ) but did not have a significant effect on medical decision making. EPs valued especially the case-based teaching and indicated that the interactive setting helped them to better understand and retain knowledge. Combined quantitative and qualitative data suggest that EPs benefit from geriatric emergency teaching.

Future enhancement and evaluation of the geriatric education program is needed to confirm benefits to clinical practice and patient outcomes.

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## Introduction

Demographic changes have led to a worldwide increase of older adults attending the Emergency Departments (EDs) [1–3]. This trend is a major challenge for the ED in the context of limited specific skills of emergency professionals in caring for this population [2, 4]. Providing emergency care to older adults is often perceived by ED professionals as time consuming and complex in a setting that has been organized according to single organ assessment and the management of (multi)trauma and acute organ failure. However, older adults are known to present at the ED with atypical presentation of symptoms, multiple co-morbidity and polypharmacy [5, 6]. Various studies have reported that physicians feel incompetent and unconfident in dealing with such complex older patients due to the under-representation of older patient care issues in the medical curricula [7–11]. Moreover, emergency physicians (EPs) are not specifically trained nor have guidelines for the care of older people, especially relating to frailty and geriatric syndromes

[12]. The lack of competence and confidence of EPs in dealing with complex older patients is considered an important factor for why older adults more often have unnecessary diagnostics and treatment at the ED [11, 13], a prolonged ED length of stay [14, 15], a higher risk of hospitalization [14, 16] and more frequent ED revisits compared with younger adults who visit the ED [17].

To attain better quality of care for older adults attending the ED, it is important for EPs to acquire adequate geriatric knowledge and skills of the most common geriatric emergency problems. The competencies associated with geriatric medicine, such as delirium identification and falls management, are just as important in the acute as they are in the more typical geriatric ward setting [12]. In an attempt to equip EPs better, and consequently improve the quality of geriatric emergency care for older adults, we developed a 9-month geriatric emergency education program. The purpose of this study is to evaluate the effect of the program on EPs' geriatric knowledge, attitude and medical practice when treating older adults at the ED, and to explore EPs' experiences with the program.

## Materials and methods

### Design

We used a mixed-methods study to quantitatively evaluate the effect of the program on EPs' knowledge, attitude and medical practice, and qualitatively gain insight into the perceived effects of and experiences with the program. [Table I](#) shows the features of the geriatric education program we developed. The program was a mix of an online training and lectures. The themes of the lectures were all outlined by the European Task Force on Geriatric Emergency Medicine (ETFGEM) as relevant for the competencies of EPs [18]. It was not feasible to cover all themes outlined by ETFGEM. Therefore, a relevant selection of themes outlined by ETFGEM was selected for this education program. The online training and the interactive sessions were all in Dutch (content of both are

**Table I.** *Features of the geriatric education program*

1. The program started in February 2016 and ended in October 2016.
2. 6 weeks online training<sup>a,b</sup>:
  - Module 1: Frailty and frail elderly patients
  - Module 2: Delirium and cognitive impairment
  - Module 3: Functional decline
  - Module 4: Polypharmacy
  - Module 5: Shared-decision making
  - Module 6: Summary of themes and examination
3. Monthly interactive lectures (March–October 2016)<sup>b</sup>:
  - Duration of session: 2 h
  - An experienced geriatrician acted as lecturer
  - Focus on geriatric syndromes of frequent occurrence
  - Focus on the organization of pre-hospital elderly care
  - Use of multiple cases (real stories), including cases with falls

<sup>a</sup>Developed by The Royal Dutch Medical Association. Time investment was 1.5–2 h per module per EP.

<sup>b</sup>Content is available upon request. EP, emergency physician.

available on request). The study was carried out in the Netherlands in accordance with the applicable rules concerning the review of research ethics committees.

### Setting and population

All 13 physicians (including residents) working in the period 2015–17 at the ED of the Radboud University Medical Center (Radboudumc; an academic Level I trauma center with a 650-bed capacity and an annual census of approximately 22 000 patients) participated in the online training and attended the interactive lectures. The mean attendance was 53% (range 13–88%). Eight of the 11 EPs working at the Canisius Wilhelmina hospital (CWZ; a regional hospital, with a 458-bed capacity and an annual census of 25 000 patients) followed the online training. It was not feasible for EPs working in the CWZ to participate at the interactive lecture sessions.

### Data collection

Before and after the program, participants were asked to fill in a multiple choice knowledge test

(in Dutch) containing 10 questions about common geriatric syndromes, which are also outlined by ETFGEM [18]. The pre-test consisted of different questions compared with the post-test, but both tests were equal in terms of assessing EP's knowledge level. It was developed by an experienced geriatrician with educational expertise. This test was checked by a panel of geriatricians and revised as needed. Also, two validated questionnaires were distributed before and after the program. The Needs Assessment scale was translated to Dutch and used to evaluate participant's self-perceived knowledge regarding most common geriatric syndromes [19]. The Needs Assessment scale consists of 18 questions on a 5-point Likert scale. A higher score indicates more self-perceived knowledge. The Aging Semantic Differential (ASD) was translated to Dutch and used to measure participant's attitudes toward older adults (e.g. pleasant–unpleasant, friendly–unfriendly and cooperative–uncooperative [20]). The ASD consists of 27 items on a 7-point Likert scale referring to aging stereotypes. A lower score indicates a more positive attitude toward older persons. To our best knowledge, ASD has not been used before at an Emergency Department setting.

Additionally, 100 medical records were retrospectively analyzed, to assess before–after effects on EPs' medical practice by completeness of a comprehensive geriatric assessment (CGA [17]). Fifty records before the start of the program (patients treated at the ED between August and October 2015) and 50 records after completion of the program (patients treated at the ED between August and October 2016) were randomly selected. Records of patients aged 70 years or more attending the ED of the Radboudumc and treated by an EP for presenting complaints in the fields of geriatrics, neurology, surgery, orthopedics or pulmonology were eligible for review. Records of patients with the most urgent triage code, U0, were excluded from selection, because a CGA is often impossible to perform in such cases. Triage levels were determined by using the Netherlands Triage System (with U0 being the highest urgency and U5 being the lowest urgency). Eligible records in the before and after study periods were consecutively selected

and equally divided between surgical specialties (surgery, orthopedics) or analytic specialties (i.e. geriatrics, neurology and pulmonology). Two reviewers with a medical background (N.H. and E.Ö.) independently reviewed the selected records on the documentation of EPs' history taking, requested diagnostics, consultation of medical specialties and problem definitions of CGA. We chose to evaluate the records on these variables as these care processes may be under- or over-performed by EPs without sufficient education in geriatric emergency medicine [11, 13]. A third reviewer (Ö.S.) made final decisions on assessment discrepancies by N.H. and E.Ö.

Semi-structured interviews were conducted from March through June 2017 with EPs of the Radboudumc. We approached all EPs, who participated in the program. Interviews were held in Dutch at the ED staff's office by a trained interviewer (G.H.) and lasted between 20 and 30 min. During the interviews, the following topics were discussed: (i) experiences with the program (e.g. educational approach, content, organization and learning climate), (ii) impact of the program on geriatric knowledge, attitude toward older adults and treatment of older adults and (iii) suggestions for improvement. Interviews were digitally recorded and transcribed verbatim. The excerpts of the interviews were translated to English. Anonymity of the interviewees was guaranteed to maximize candid discussion. Interviews were held concurrently with the analysis of transcripts to determine data saturation.

### **Data analysis**

Quantitative data were analyzed using SPSS Statistics version 23.0. The Shapiro–Wilk test was applied to assess the normality for the distribution of the data. Independent two-sample *t*-test and Mann–Whitney *U*-test were used to compare baseline characteristics. We used basic descriptive statistics to present questionnaire and multiple choice test scores (i.e. mean and standard deviation) and medical record assessment scores (i.e. frequency and percentage). Missing data in the multiple choice test were scored as 'wrong answer'. Paired sample

*t*-test, chi-square test, Fischer's exact test, Mann-Whitney *U*-test and Wilcoxon Signed Rank test were used as appropriate to compare before and after data. A significance level of  $P < 0.05$  was used to determine statistical differences.

Interview transcripts were analyzed in line with Braun and Clarke's outline of the thematic analysis process [21]. Detailed reading and re-reading of transcripts led to the generation of initial codes. Codes were generated in a systematic fashion across all transcripts. Subsequently, codes were combined under overarching themes that were internally coherent, consistent and unique from each other. All transcripts were initially coded by G.H. Credibility checks were carried out by Ö.S. for quality control purposes, who read and coded all transcripts at different stages of the analysis process. We used computer-assisted qualitative data analysis software (Atlas.ti version 8) to manage and code the transcripts.

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## Results

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### Demographics

All 13 EPs from the Radboudumc and 8 EPs from the CWZ hospital (3 dropped out because of sickness, leave and a job transfer, respectively) participated in the quantitative evaluation. Patients characteristics retrieved from retrospective record analysis are shown in Table II. Patients characteristics did not significantly differ between pre- and post-groups on gender, age, referral, triage, length of stay and discharge destination. For the qualitative study, six EPs were interviewed, all working at the ED of the Radboudumc. EPs working in the CWZ were not interviewed due to reasons of availability (clinical duties, vacation, etc.).

### Effects on geriatric knowledge of EPs

Radboudumc EPs performed significantly better on the multiple choice geriatric knowledge test after completion of the program ( $P < 0.01$ ; Table III). Geriatric knowledge did not significantly improve for CWZ EPs ( $P = 0.47$ ). Post training geriatric knowledge of EPs working at the Radboudumc

( $6.8 \pm 1.2$ ) was significantly higher ( $P < 0.001$ ) when compared with EPs working at the CWZ ( $6.0 \pm 0.9$ ). At baseline, there was a significant difference in the self-perceived geriatric knowledge between physicians working in Radboudumc and CWZ: 41.8 versus 49.1, respectively ( $P = 0.03$ ). Self-perceived geriatric knowledge among EPs in both hospital settings increased significantly ( $P \leq 0.01$ ).

Interviewed EPs expressed that the program improved their knowledge of geriatric syndromes and how to discern syndromes that manifest in a fairly similar way (e.g. depression, delirium and dementia). According to interviewees, the program also provided them practical tools to (better) perform a geriatric assessment of the patient and to recognize specific cognitive syndromes. Several EPs mentioned that the program also improved their understanding of the organization of elderly care in the community in terms of allocation of responsibilities, referral procedures, terminology, available services and contact persons. This information, provided during the program, gave them more insight in how to organize a smooth patient transition to the community (e.g. home or nursing home).

EP 4: The organization of prehospital elderly care is a complete maze, totally incomprehensible for everyone involved. (...) A transfer nurse had to come over to explain how it all worked. And that really helped us in gaining a clear view of the situation. At least now we know what we are talking about.

Interviewees indicated that the program did not only improve their ability to define and recognize frailty. The program helped EPs to shift from a traditional approach of focusing on the patient's acute medical problem toward a more holistic view of the patient's condition and needs.

EP 4: The fact that you are able to distinguish between an elderly patient who basically needs regular treatment and a frail elderly patient who needs to receive a different type of treatment. (...) That is one of the most important things I have learned now.

**Table II.** Patient characteristics of the retrospective analyzed medical charts

	2015 (n = 50)	2016 (n = 50)	P-value
Gender			0.55
Male, n (%)	25 (50)	22 (44)	
Female, n (%)	25 (50)	28 (56)	
Age, mean years (SD)	79.5 (6.1)	78.8 (6.9)	0.53
Referral			0.22
Self-reference, n (%)	8 (16)	3 (6)	
GP, n (%)	13 (26)	20 (40)	
Ambulance, n (%)	23 (46)	19 (38)	
Specialist, n (%)	6 (12)	8 (16)	
Triage level <sup>a</sup>			0.35
Emergent, n (%)	19 (38)	27 (54)	
Urgent, n (%)	18 (36)	19 (38)	
Non-urgent, n (%)	1 (2)	1 (2)	
Advice, n (%)	6 (12)	2 (4)	
Missing, n (%)	6 (12)	1 (2)	
Medical specialty			1.00
Geriatrics, n (%)	10 (20)	10 (20)	
Pulmonology, n (%)	9 (18)	9 (18)	
Neurology, n (%)	6 (12)	6 (12)	
Surgery, n (%)	18 (36)	18 (36)	
Orthopedics, n (%)	7 (14)	7 (14)	
ED LOS, mean hours:minutes (SD)	4:05 (2:09)	4:12 (2:44)	0.87
Hospital LOS, mean days (SD)	3.84 (7.6)	2.48 (4.8)	0.37
Discharge destination from the ED			0.97
Home, n (%)	23 (46)	23 (46)	
Geriatric unit, n (%)	11 (22)	9 (18)	
Other inpatient medical unit, n (%)	15 (30)	16 (32)	
Nursing home, n (%)	1 (2)	1 (2)	
Other hospital, n (%)	—	1 (2)	
Deceased, n (%)	—	—	
Discharge destination after hospitalization			0.83
Home, n (%)	39 (78)	37 (74)	
Other hospital, n (%)	3 (6)	5 (10)	
Nursing home, n (%)	7 (14)	8 (16)	
Deceased, n (%)	1 (2)	—	
ED revisit <14 days, n (%)	4 (8)	2(4)	0.68

GP, general practitioner; LOS, length of stay; ED, Emergency Department; SD, standard deviation.

<sup>a</sup>Based on the emergency levels (1–5) of the Netherlands Triage System: (1) life threatening, (2) emergent, (3) urgent, (4) non-urgent and (5) advice.

EP 5: We are simply not used to inquire after the home situation of patients. We prefer quick and fast and not too complicated and not too long. And that is not a problem when you are dealing with a 36-year-old patient with a fractured ankle. The question is whether you can expect that from someone who is 83 years old, whose wife has just died

and who has to look after his son for the first time in his life. The [program] has certainly created that specific type of awareness which I did not have before.

Moreover, EPs expressed to better understand the implications of caring for a frail older person at the ED after following the program. For example, the

**Table III.** Pre–post effects of the geriatric education program on geriatric knowledge and attitudes toward older adults

Participants	Geriatric knowledge <sup>a</sup>			Self-perceived geriatric knowledge <sup>b</sup>			Attitudes toward older adults <sup>†c</sup>		
	Pre, mean (SD)	Post, mean (SD)	<i>P</i> -value	Pre, mean (SD)	Post, mean (SD)	<i>P</i> -value	Pre, mean (SD)	Post, mean (SD)	<i>P</i> -value
Radboudumc EPs ( <i>n</i> = 13)	5.1 (1.6)	6.8 (1.2)	<b>&lt;0.01</b>	41.8 (6.6)	54.0 (6.3)	<b>&lt;0.01</b>	94.62 (8.7)	91.5 (12.9)	0.27
CWZ EPs ( <i>n</i> = 8)	5.4 (1.7)	6.0 (0.9)	0.47	49.1 (6.4)	54.5 (5.2)	<b>0.01</b>	94.3 (12.0)	92.9 (11.9)	0.75

EP, emergency physician; CWZ, Canisius Wilhelmina hospital. Statistically significant values are in bold.

<sup>a</sup>Based on multiple choice knowledge test (score range: 0–10).

<sup>b</sup>Needs Assessment Scale (score range: 18–90).

<sup>c</sup>Aging Semantic Differential (27–189).

importance of consulting the geriatrician on time, considering treatment restrictions/end-of-life care, gaining insight into the patient's social situation and being more alert on the patient's medication use and possible side effects.

EP 3: I am much more aware now of frail patients and (...) of futile medical treatment (...). We are very quick to turn to the medical protocol, but perhaps that protocol is not very well suited to elderly patients with many comorbidities.

EP 2: For instance when you are dealing with an elderly patient with a fractured arm. You tend to think: 'Well, the fracture has been set in any case.' But a whole network has to be organized around the patient. We have been made very much aware of the importance of that.

### Effects on attitudes toward older adults

The attitude of EPs and ED residents toward older adults did not change before and after the program ( $P = 0.27$ ; Table III). When comparing scores of EPs and ED residents as separate groups, no significant difference in attitudes before and after the program was found either ( $P = 0.35$  and  $P = 0.80$ , respectively). Interviewees expressed that the program did not change

their view on older adults other than their improved ability to discern frail older adults from regular older adults.

### Effects on EPs' medical practice

EPs gave statistically significant more attention to the patient's social circumstances after the program (32% versus 54%  $P = 0.04$ ; Table IV). Overall, more diagnostics were performed for older patients after the program, and EPs examined more often the patient's sensory capacity and ability to perform activities of daily living (ADL), but statistical significance for found differences lacked. No statistical significant differences were found for the consultation of a geriatrician and other medical specialties, and EPs' problem definition of CGA before and after the program.

According to interviewed EPs, the program improved the collaboration between the EP and the geriatrician. Interviewees described that they contact the geriatrician at a much earlier stage nowadays, because they are better able to formulate their request to the consultant geriatrician. One interviewee also expressed, that the program helped her to see the geriatric consult as a mean for determining appropriate patient care based on the input of the geriatrician, rather than as a mean for handing over the patient to the geriatrician. This made her less hesitant to call the geriatrician.

**Table IV.** Pre–post effects of the geriatric education program on EPs' medical practice

	Pre (n = 50)	Post (n = 50)	P-value
<b>History taking</b>			
Fall risk, n (%)	13 (26)	7 (14)	0.21
Cognitive status, n (%)	7 (14)	5 (10)	0.76
Delirium, n (%)	1 (2)	0 (0)	1.01
Mood, n (%)	1 (2)	1 (2)	1.00
Behavior (e.g. passive, aggressive, nervous), n (%)	2 (4)	2 (4)	1.00
Nutritional status, n (%)	4 (8)	4 (8)	1.00
Incontinence (urinary or fecal), n (%)	6 (12)	4 (8)	0.74
Social circumstances <sup>a</sup> , n (%)	16 (32)	27 (54)	<b>0.04</b>
Sensory capacity <sup>b</sup> , n (%)	1 (2)	6 (12)	0.11
Basic ADL <sup>c</sup> , n (%)	6 (12)	14 (28)	0.07
IADL <sup>d</sup> , n (%)	3 (6)	9 (18)	0.12
<b>Performed diagnostics</b>			
Use of laboratory tests, n (%)	29 (58)	36 (72)	0.21
Use of urinary tests, n (%)	10 (20)	12 (24)	0.81
Use of ECG, n (%)	26 (52)	30 (60)	0.55
Use of X-rays, n (%)	41 (82)	43 (86)	0.79
<b>Consultation requests</b>			
Consultation from any type of medical specialist, n (%)	41 (82)	37 (74)	0.47
>1 medical specialists in consultation, n (%)	17 (34)	11 (22)	0.25
Consultation from geriatrician, n (%)	13 (26)	12 (24)	0.82
<b>Problem definition of CGA</b>			
Medical assessment, n (%)	50 (100)	50 (100)	1.00
Psychological assessment, n (%)	2 (4)	2 (4)	1.00
Assessment of functioning, n (%)	4 (8)	1 (2)	0.36
Social assessment, n (%)	4 (8)	2 (4)	0.68

ADL, activities of daily living; IADL, instrumental activities of daily living; ECG, electrocardiogram.

<sup>a</sup>Information on patient's living condition, household and (in)formal support received at the home or in the community.

<sup>b</sup>Vision, hearing, smell, taste, peripheral sensation.

<sup>c</sup>Basic self-care tasks: i.e. eating, washing, dressing, functional mobility, toilet hygiene and grooming.

<sup>d</sup>Tasks that people need to manage in order to live at home and be fully independent: i.e. moving within the community, preparing meals, managing money and doing groceries.

EP 2: I think you are more aware of being in this together. That you do not ask someone to take part in the consultation because you very much want to hand over the complete care for the patient to him or her, but because you want to discuss things: 'How are we going to deal with this together? What is the best thing to do?' (...) And because of that you are also more inclined to phone [the geriatrician].

Moreover, interviewees expressed that they seek input from the geriatrician more often, because the program made them more aware of the added value of the geriatrician

when diagnosing and treating older patients at the ED.

EP 6: I tend to call the geriatrician much more now to discuss things: 'We have this female older patient here with a fractured hip, but I am not just asking you for a preoperative consultation. The patient is frail because of various things. And I do not think that she should be operated on.' (...) Whereas previously (...) I would formulate a request as: 'The orthopedic surgeon would like to operate, and I would like you to come and check whether the patient is in a fit state for undergoing surgery.'

Several interviewees indicated to be more alert on the medication use of older patients and possible side effects. Interviewees also mentioned to be more attentive to their older patient's social circumstances. They described that the program improved their ability to map the social–psychological care needs of older patients, which helps them to determine appropriate follow-up.

EP 3: I have become more attentive to the social circumstances of the patient. How will the patient return home? And how does it go from there? Who will be able to do things for the patient? Or would it be better for the GP to request more urgent care? I have become much more alert to that.

### **Experiences with the geriatric education program**

Interviewees were generally satisfied with organization of the program. The interactive lectures were scheduled close after the monthly EP staff meeting, so that most of the EPs could attend the lectures. The frequency of geriatric education (i.e. e-learning and interactive lectures) was perceived differently. Several interviewees argued the importance of frequent education within a short time period to memorize and translate the lessons learned into practice. On the contrary, others asked for less frequent hours on geriatric education to reserve sufficient education time for other relevant topics (e.g. pediatrics and addiction care).

EP 1: Our specialty is very broad, considering all the various patients we see. So I would be interested in receiving more education about this [emergency geriatrics], but perhaps less frequent. That way you can also pay attention to other specialties.

Interviewees shared both positive and negative experiences with the e-learning component of the program. Several EPs appreciated being able to control the tempo of the education within the e-learning modules and the ability to determine themselves when to complete the modules. Others criticized the

online education form, because of the one-way stream of—often theoretical and irrelevant—information. Most EPs were very positive about the interactive case sessions. The in-depth analysis of actual cases in an interactive setting helped EPs better understand and memorize lessons learned. Moreover, it triggered EPs to reflect on their own experiences with older patients at the ED and on the experiences of their colleagues.

EP 4: Whenever there is a discussion that is when it becomes really interesting for me, and also easier to remember and to understand. You can learn things, but I think it is more important to deepen your understanding through discussion (of cases) and with that your comprehension of things.

According to interviewees, the lecturer had an important role in the EPs' learning process by providing constructive feedback to participants, moderating group discussions, anticipating on participant needs and by letting EPs first explore geriatric problems and possible care approaches themselves before giving feedback.

Although interviewees described mainly positive experiences with the program, many felt that the program requires further improvement to ensure that the most essential geriatric information and skills are memorized by EPs and ultimately become part of their routine practice. According to them, the use of a 'take home messages' and summary recaps of previous education sessions, and easy access for EPs to education material (e.g. presentation slides, minutes, recordings, references and the description and geriatric analysis of cases) could contribute to the further improvement of the program.

EP 1: It is a pity that no minutes were made during the program. That way you could say: 'Alright, I missed a few things, but I can just check the minutes to find out what it was about.' Now I feel that there is a lot that I should know about, but I cannot find out what it was. (...) [The lecturer] gave us a great deal of useful advice. So it would have been nice if



we could have looked that up again somewhere.

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## Discussion

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Our quantitative findings show that the geriatric training program may increase the EPs' knowledge in geriatric medicine. These findings are supported by the interviews with participants; the program improved their ability to recognize frailty and geriatric syndromes and their attentiveness for recognizing vulnerable older patients at the ED.

There were several limitations to our study. First, because there was no coexisting control group (as each EP served as his or her own control), we cannot ascertain whether the educational program was the cause of the improved knowledge. The observed (lack of) effects could be explained by societal attention for the growing number of older adults attending the ED, EPs' experiences with older adults or pre-existing educational materials [22]. Second, outcome effects and experiences with the program were based on a relatively small sample of EPs and medical charts. Only the effects on (self-)perceived geriatric knowledge and attitudes toward older adults were based on a larger sample, including EPs from a second hospital. Moreover, the program was fully implemented and evaluated at only one hospital with an existing geriatric consultation service. This limits the generalizability of our findings to other hospitals. However, this type of program may have an even greater effect at other institutions that lack such a service, because EPs may find greater benefit from this added educational initiative. Third, there were several limitations to the measurement of program effects. It is possible that the number of questionnaire items was insufficient to adequately measure change. We did not perform a test-retest reliability check to determine the stability and consistency of the multiple choice knowledge test. Therefore, found changes in EP's knowledge may be a random effect. We did not apply methods (e.g. Bonferroni correction) to reduce the chance of obtaining false-positive results (Type I errors) when performing multiple statistical

comparisons on a single set of patient record data. Therefore, we cannot fully rule out that EP's improved attention for the older patient's social history and circumstances after following the educational program may be an erroneous significant effect purely by random chance. Furthermore, we did not evaluate pre and post use of chemical sedation and catheter placement while both are previously identified as valid indicators for measuring EP's appropriate medical handling when caring for older adults at the ED [21]. Despite we guaranteed anonymity, it is also possible that self-perceived knowledge scores and self-reported improvements in practice after completion of the program could be attributed to social desirability [23]. However, the 8-month period between pre- and post-questionnaires made it difficult for participants to recall their previous answers. On the other hand, the half-year period between the ending of the program and the start of interviews may have led to recall bias in perceived experiences with the program. Furthermore, the reviewers of the medical charts were not blinded to the study purpose and timing of the program. This may have introduced bias that could overestimate the effect of the program. Finally, some may consider evaluations of clinical practice and patient outcomes more substantial outcome measures. We recognize that practice change and patient outcomes are important endpoints of education interventions and they should be part of future research.

In the Netherlands, Emergency Medicine is not a recognized specialty yet. Post-graduate physicians are recognized as EPs after completing the Emergency Medicine residency curriculum. The Dutch Emergency Medicine residency curriculum was started in 2000 and consists of 3 years of residency [24]. Currently, almost all Emergency Departments in the Netherlands are staffed by EPs. Previous studies have shown that EPs lack geriatric competencies, most likely because these competencies are not implemented neither in core curricula nor in post-graduate residency training [8, 21]. Recently, the ETFGEM produced a European Curriculum of Geriatric Emergency Medicine that outlines competencies relevant to the emergency care of older patients [18]. When implemented in

residency training, future EPs in the Netherlands could benefit from this geriatric curriculum. However, current EPs could only benefit from courses, workshops or (local) education programs. The current study evaluates the effects of a local geriatric education program for EPs. Previous studies have addressed the importance of early detection of patients with geriatric syndromes at the ED and the ability of EPs to differentiate these syndromes from other cognitive impairments for the sake of effective and timely care [25]. Our program also had a positive impact on the understanding of elderly care agencies and organization structures in the community. This is an important finding considering that lack of knowledge about post-hospital care has been associated with poorly executed care transitions leading to high-risk events for elders, such as re-hospitalizations [26, 27]. Attitudes toward older adults did not change following the program. This finding corresponds with previous studies illustrating that change of attitudes toward older adults is complex [28], and that the ability of current measures to capture that complexity is questionable [29]. The lack of change in attitudes may also be explained by the content of the program that is intentionally aimed to improve EPs' knowledge and skills in geriatric emergency medicine rather than on altering (mis)perceptions of elderly and aging stereotypes. Furthermore, the intensity level and duration of the program may have been insufficient to realize considerable change in attitudes. Our finding that no significant attitudinal changes occurred toward elderly patients is in line with other studies assessing the attitude of EPs post geriatric training [21, 30]. The studied medical charts showed increased attention for the older patient's social history and circumstances. This is an important finding, because social circumstances have been identified as a key variable in understanding—and reducing—patient ED revisits [31–34]. Better understanding of the patient's living situation, presence of informal carers and daily routines helps physicians to identify specific care needs and organize appropriate follow-up care. Although no

statistically significant pre–post changes were found in medical decisions by EPs, the interviews provide a more nuanced view as EPs felt more inclined and confident to consult the geriatrician when caring for an older adult with suspected frailty. This is a promising finding knowing that early specialist review or advice by a geriatrician can improve the quality of care at the ED and disposition decisions for older adults [35, 36]. Moreover, geriatric consultations also have an educational function by the dissemination of geriatric knowledge and provision of geriatric feedback by geriatricians to EPs [37].

Participant experiences with the program illustrate that web-based learning may be an effective strategy for reaching EPs who often work irregular hours and in separate shifts [38]. However, the interactive case-based sessions were considered most useful by EPs. Unraveling complex cases with fellow colleagues and theoretical input helped them to better understand the underlying mechanisms of complaints and symptoms of older adults presented at the ED, and the implications for medical practice. This is in accordance with literature describing case-based teaching as an effective way to bridge the gap between theory and practice, allowing students to take better advantage of their grounding in basic sciences to solve complex patient-oriented problems [39]. In addition, previous research suggests that interactive learning yields higher retention of information and learner satisfaction when compared with formal lectures [40–42].

The implementation of our geriatric emergency education program seems to positively affect EPs knowledge base and medical handling. This may place older adults treated in the ED at decreased risk of adverse outcomes. This study also gave us insight into the pre-conditions for an effective geriatric education program for EPs through the experiences of EPs. Further research is however required to confirm the educational benefits of this program, primarily by evaluating the program on a larger study sample and using clinical practice and patient outcome measures in addition to the use of validated geriatric knowledge measurement tests.

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## Author contributions

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Ö.S., G.H. and Y.S. were involved in conception and design of the study. Ö.S. and G.H. were equally responsible for data acquisition, and both analyzed and interpreted all the data. N.H. and E.Ö. both analyzed and interpreted quantitative data. G.H. and O.S. drafted the manuscript, which was critically revised for important intellectual content by E.Ö., N.H., M.O.R. and Y.S.

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## Conflict of interest statement

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None declared.

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