

Improving ICU services in resource-limited settings: Perceptions of ICU workers from low-middle-, and high-income countries

Title Page

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Abstract

Purpose: To compare perceptions of intensive care unit (ICU) workers from low-and-middle income countries (LMICs) and high income countries (HICs) on barriers and strategies to improve LMIC ICU services.

Materials and Methods: Questionnaire-based survey including 175 LMIC and 43 HIC ICU workers.

Results: LMIC ICU workers perceived lack of formal training of ICU workers (6-point Likert score median 3 [IQR 3]), lack of nurses (3[3]), and low wages (3[4]) as major barriers to ICU functioning. Suggested strategies for improvement were training of ICU staff (4[3]), an increase in nursing staff (4[2]), collection of outcome data (3[4]), and maintenance of available equipment [3(3)]. The most useful role of HIC ICU staff was training of LMIC staff (4[2]). Donation of equipment [2 (4)], drugs [2 (4)], and supplies (2[4]) perceived to be of limited usefulness. HIC and LMIC ICU staff significantly differed ($p<0.05$) in their perception on barriers and strategies to improve LMIC ICU services such as relevance of the lack of; critical care training, leadership supplies and equipment, and on the usefulness of improving training, data collection and access to equipment.

Conclusion: Our survey provides relevant insight into perceptions of LMIC and HIC ICU workers on how to improve LMIC ICU services.

Word count: 200 words

Key words for indexing: Perceptions, ICU workers, resource-limited settings, improving ICU services

Introduction

Globally, the burden of critical illness is highest in low- and middle-income countries (LMICs) [1,2]. Despite an increasing number of intensive care units (ICU) in these areas, the mortality and long-term morbidity of critical illness is disproportionately higher than in high-income countries (HICs) [2-4]. Given that children and young adults make up a relatively large proportion of critically ill patients in LMICs [4-6], the social and economic burden of critical illness, and the potential for gains, is enormous. Poor functioning of many ICU services, among other factors, contributes to adverse outcome of critical illness in LMICs [2,7-9].

Optimum ICU function depends on a delicate balance of staff availability and training, material resources and organizational processes [10]. Due to major differences in funding capacities, resource availability, cultural and social factors between LMICs and high-income countries (HICs), it is likely that strategies to improve ICU services differ between LMICs and HICs. ICU workers from LMICs have the best insight which obstacles prevent optimum function of LMIC ICUs and which strategies would be most acceptable and useful to improve these services. They are also the ones who can best suggest how ICU workers from HIC may assist in this process. So far, however, no such data has been published. Knowledge of perceptions and ideas of ICU staff from LMICs would be of great importance to overcome obstacles, improve the care of critically ill patients in LMICs, and guide cooperation between LMIC and HIC ICU staff.

Our survey aimed to collect perceptions of ICU workers from LMICs on barriers and strategies to improve LMIC ICU services and compare these with perceptions of ICU staff from HICs. We hypothesized that perceptions of ICU workers from LMICs and HICs differed.

Materials and Methods

This study was performed as an anonymous online, questionnaire-based survey over a three-month period in 2016. Ethical review was not sought as the survey was anonymous, voluntary and contained no patient material or alluded to individual persons.

Participants

The survey targeted healthcare professionals (physicians and nurses) substantively employed in an ICU in a LMIC (as defined by the World Bank). In addition, ICU workers from HICs who have worked in a LMIC ICU could also participate in the survey. The survey was endorsed by the European Society of Intensive Care Medicine and the World Federation of the Societies of Intensive and Critical Care Medicine. Both societies publicized the survey to their members. In addition, individual and group invitations to participate in the survey were sent out by members of the Global Intensive Care working group of the European Society of Intensive Care Medicine. A reminder invitation was sent out after two weeks.

Survey Instrument

The study questionnaire was available on a dedicated webpage. The full survey tool can be downloaded from the electronic supplementary material. Briefly, it was composed of six sections which focused on the following topics: 1) characteristics of the respondent and associated LMIC ICU service; 2) availability of ICU resources); 3) barriers to LMIC ICU function; 4) strategies to improve LMIC ICU function; 5) importance of additional staff; 6) ways how HIC ICU staff can help to improve LMIC ICU services. Survey respondents were asked to rate their perceptions on a 6-point Likert scale for each question (0 being the lowest and 5 the highest). Free text responses were minimized to facilitate statistical analysis and interpretation. The survey tool was available in English, Spanish, Portuguese and French.

The questionnaire was developed by three authors (RH, MD, LdeA) and underwent pre- and pilot-testing by the other co-authors with regard to sequence, salience, acceptability and administrative ease. Inter-rater reliability was assessed at the same time. Finally, clinical sensitivity testing and testing for internal validity was performed by experts of the European Society of Intensive Care Medicine Global Intensive Care working group which included health care workers from HICs and LMICs.

Data Processing and Statistical Analysis

After study questionnaires had been completed, data were automatically transferred into the spreadsheet of a statistical software program. At the end of the study period, questionnaire accessibility through the study homepage was blocked and raw data checked independently by two authors for plausibility and quality. Open-ended questions were numerically coded. All statistical analyses were carried out using the Stata[®] 13 software package. Data are presented as median values with inter-quartile ranges, if not given otherwise. The Mann Whitney-U test was used to assess differences in the responses of LMIC and HIC respondents. *P*-values <0.05 were considered to indicate statistical significance.

Results

A total of 175 LMIC and 43 HIC ICU workers participated in the survey. Their geographic origin (Figure 1), age and professional distribution are presented in Table 1.

Table 1 Characteristics of respondents and associated LMIC[†] ICU[‡] services.

Variable	LMIC [†] (n=175)	HIC [‡] (n=43)
Age		
<35 years	35 (20.1%)	6 (15%)
≥35-45 years	74 (42.5%)	15 (37.5%)
≥45-55 years	41 (23.6%)	12 (30%)
≥55-65 years	22 (12.6%)	7 (17.5%)
≥65 years	2 (1.2%)	0
Missing	1 (0.6%)	6 (14%)
Continent of residency		
North America	0	16 (37.2%)
Central America	4 (2.3%)	0
South America	80 (45.7%)	0
Europe	9 (5.1%)	24 (55.8%)
Africa	28 (16%)	0
Asia	54 (30.9%)	3 (7%)
Role		
Critical care specialist physician	142 (81.2%)	32 (74.4%)
Junior physician	19 (10.8%)	4 (9.3%)
Nurse	14 (8%)	7 (16.3%)

ICU† work experience		
<1 year	4 (2.3%)	1 (2.3%)
1–2 years	15 (8.6%)	2 (4.7%)
3–5 years	26 (14.9%)	8 (18.6%)
6–8 years	31 (17.7%)	8 (18.6%)
9–10 years	16 (9.1%)	3 (7%)
> 10 years	83 (47.4%)	21 (48.8%)
Duration of work in LMIC‡ ICU†		
<1 month	-	19 (44.2%)
1–5 months	-	12 (27.9%)
6–12 months	-	5 (11.6%)
>12 months	-	7 (16.3%)
<1 year	20 (11.4%)	-
1–2 years	30 (17.1%)	-
3–5 years	43 (24.6%)	-
6–10 years	34 (19.4%)	-
>10 years	48 (27.4%)	-
Location of LMIC‡ ICU†		
Central America	5 (2.9%)	0
South America	79 (45.1%)	2 (4.6%)
Europe	9 (5.1%)	2 (4.6%)
Africa	27 (15.4%)	12 (27.9%)

Asia	55 (31.4%)	27 (62.8%)
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LMIC, low- and middle income country; †ICU, intensive care unit; ‡HIC, high-income country

Figure 2 summarizes perceived barriers and their relevance to ICU function. LMIC and HIC respondents differed in their perception of the relevance of lack of critical care training of ICU staff, leadership of physicians, ICU beds, drugs, supplies, leadership of nurses, ventilators, monitors, and water/electricity/gas, as well as low morale, poor laboratory and radiology support. LMIC respondents who worked in non-privately funded ICUs considered the lack of nurses and material resources a more relevant barrier to ICU functioning than LMIC respondents working in private ICUs (Table S2). Suggested strategies to improve LMIC ICU performance and their relevance are displayed in Figure 3. Group differences were observed for the perceived relevance of improving training of ICU physicians and nurses, equipment maintenance, gathering of outcome data, and the need for pulse oximeters, blood gas analysers, central venous pressure monitoring, and improved oxygen systems. LMIC respondents working at non-privately funded ICUs considered equipment maintenance and increasing the availability of ICU resources of greater benefit to improve ICU services than LMIC respondents working at private ICUs (Table S3). Perceptions on the relevance of additional staff to improve LMIC ICU function are given in Figure 4. Respondents from LMICs and HICs differed in their perceived relevance of additional physicians and psychologists. Figure 5 displays proposed ways how HIC staff can help improve LMIC ICU performance. LMIC and HIC respondents differed in their perceived relevance of HIC physicians to train ICU staff in LMICs, access to journals, LMIC physicians to travel to

HICs, online training, LMIC physicians attending HIC conferences, conductance of research, setting up ICU registries, and provision of electronic patient records.

Discussion

Our survey collected perceptions on obstacles to the function of and strategies to improve ICU services in LMICs. Although respondents from LMICs originated from all continents, the absolute number of LMIC survey participants (n=175) was low given the amount of ICUs and population in LMICs. Unlike in HICs where databases to approach ICU workers exist, this is not available in most LMICs. Reaching out to nurses turned out to be especially challenging and resulted in a low percentage of nurse respondents (8%), perhaps impeded by the online format and limited languages utilised. We deliberately included only HIC ICU staff who have worked in a LMIC ICU as they were likely to have some insight into the practice of intensive care in a resource-limited setting. While it is a general limitation of surveys that perceptions instead of objective data are collected, we chose this design as we specifically intended to collect ideas and views on how to improve ICU services in LMICs.

Lack of training, lack of nurses and low wages were considered the greatest barriers to adequate ICU functioning. In contrast to most HICs, no systematic curricula for intensive care training are available for physicians and nurses in many LMICs [2,7,8,11]. Many ICUs in LMICs are run by physicians or non-physician staff (e.g. nurse anaesthetists) with no formal undergraduate or postgraduate ICU training [2,4,12]. Despite reports indicating a lack of both physician and non-physician ICU workers in LMIC ICUs [2,4,12], LMIC respondents only considered a lack of nurses as an obstacle to ICU function. The fact that >90% of survey participants were physicians might have influenced this result. Few data have been published on the income of ICU workers in LMICs. One study found that ICU physicians in Mongolia earned significantly less than their colleagues in Austria (140 vs. 2,300 €/month) [13].

Interestingly, lack of equipment, drugs and supply materials was not regarded as a priority obstacle to ICU functioning. This finding contrasts with the unavailability of certain equipment such as patient monitors, mechanical ventilators or renal replacement machines in the associated ICUs of study participants (Table S1). Comparisons between respondents working in privately and non-privately funded ICUs suggest that resource availability in private ICUs in LMICs is considered adequate while this is not the case in non-privately funded ICUs in these settings.

Training of ICU staff, an increase of the number of ICU nurses, collection of outcome data as well as maintenance of equipment were judged important strategies to improve LMIC ICUs. These perceptions are in line with published reports. Training of ICU staff has been associated with improved functioning of ICU services in LMICs [14-17]. The number of ICU nurses is an independent factor determining morbidity and mortality of critically ill patients [18]. Although these data largely originate from HICs, it is likely that they can be extrapolated also to resource-limited settings. ICU registries are validated methods for quality improvement and are effective in LMICs, too [19].

Overall, ICU workers from LMICs graded cooperation with ICU staff from HICs as helpful to improve LMIC ICUs. The most important role of HIC ICU staff was considered to be training of LMIC staff [15-17]. On-site training, training of LMIC staff in HIC ICUs, attendance to international scientific conferences and on-line training programs were suggested as potentially useful educational methods. Assistance with the development of clinical protocols, ICU registries, and conducting research were highlighted as other important fields where HIC staff can help to facilitate LMIC ICU functioning. Donation of equipment, drugs and supplies was felt to be of only limited usefulness by survey respondents. This perception may, however, critically depend on the availability of resources and once again varied between LMIC respondents working at privately vs. non-privately

funded ICU services. Another reason could be that ICU equipment depends on specific supply materials and is difficult to maintain or repair in LMICs [20].

Against our hypothesis, the overall ranking of barriers and strategies to improve LMIC ICU services was largely comparable between LMIC and HIC respondents. Significant differences were, however, found in the grading of their relevance. HIC respondents, for example, considered the lack of equipment and training more serious barriers to ICU functioning than LMIC respondents. The most striking difference was observed in the perception on physician leadership as an obstacle to LMIC ICU functioning. The fact that the majority of LMIC participants were (senior) physicians likely explains divergent perceptions. Participants agreed on the usefulness of HIC staff to assist with training of LMIC ICU workers. A difference worthwhile to consider when planning training of LMIC physicians, is the location of training. In contrast to HIC respondents, LMIC respondents considered it more useful that LMIC physicians were trained abroad instead of on-site. It is surprising that LMIC respondents considered setting up ICU registries and conducting research more useful than HIC participants. Given the widespread lack of data and scientific evidence from LMICs, research cooperation between HIC and LMIC staff seems to be more useful and welcome than assumed by HIC ICU workers.

Conclusions

In conclusion, ICU workers from LMICs perceived lack of training of ICU workers, lack of nurses, and low wages as major barriers to ICU functioning in LMICs. Training, increase of nurse workforce, and collection of outcome data were proposed as useful strategies to improve LMIC ICU services. LMIC respondents judged that assistance of HIC ICU staff would be helpful to train LMIC ICU workers, develop ICU registries and protocols as well as conduct research.

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