

RESEARCH

Open Access



The practice of intensive care in Latin America: a survey of academic intensivists

Ricardo Castro^{1,19*}, Nicolas Nin^{2,3}, Fernando Ríos⁴, Leyla Alegría¹, Elisa Estenssoro⁵, Gastón Murias⁶, Gilberto Friedman⁷, Manuel Jibaja⁸, Gustavo Ospina-Tascon⁹, Javier Hurtado^{2,3}, María del Carmen Marín¹⁰, Flavia R. Machado¹¹, Alexandre Biasi Cavalcanti¹², Arnaldo Dubin^{13,14}, Luciano Azevedo^{15,16}, Maurizio Cecconi¹⁷, Jan Bakker¹⁸, Glenn Hernandez^{1,19} and On behalf of the Latin-American Intensive Care Network - LIVEN (www.redliven.org)

Abstract

Background: Intensive care medicine is a relatively young discipline that has rapidly grown into a full-fledged medical subspecialty. Intensivists are responsible for managing an ever-increasing number of patients with complex, life-threatening diseases. Several factors may influence their performance, including age, training, experience, workload, and socioeconomic context. The aim of this study was to examine individual- and work-related aspects of the Latin American intensivist workforce, mainly with academic appointments, which might influence the quality of care provided. In consequence, we conducted a cross-sectional study of intensivists at public and private academic and nonacademic Latin American intensive care units (ICUs) through a web-based electronic survey submitted by email. Questions about personal aspects, work-related topics, and general clinical workflow were incorporated.

Results: Our study comprised 735 survey respondents (53% return rate) with the following country-specific breakdown: Brazil (29%); Argentina (19%); Chile (17%); Uruguay (12%); Ecuador (9%); Mexico (7%); Colombia (5%); and Bolivia, Peru, Guatemala, and Paraguay combined (2%). Latin American intensivists were predominantly male (68%) young adults (median age, 40 [IQR, 35–48] years) with a median clinical ICU experience of 10 (IQR, 5–20) years. The median weekly workload was 60 (IQR, 47–70) h. ICU formal training was between 2 and 4 years. Only 63% of academic ICUs performed multidisciplinary rounds. Most intensivists (85%) reported adequate conditions to manage patients with septic shock in their units. Unsatisfactory conditions were attributed to insufficient technology (11%), laboratory support (5%), imaging resources (5%), and drug shortages (5%). Seventy percent of intensivists participated in research, and 54% read scientific studies regularly, whereas 32% read no more than one scientific study per month. Research grants and pharmaceutical sponsorship are unusual funding sources in Latin America. Although Latin American intensivists are mostly unsatisfied with their income (81%), only a minority (27%) considered changing to another specialty before retirement.

(Continued on next page)

* Correspondence: rcastro@med.puc.cl

¹Departamento de Medicina Intensiva, Facultad de Medicina, Pontificia Universidad Católica de Chile, Diagonal Paraguay #362, Santiago Centro, RM 8330077, Chile

¹⁹Unidad de Paciente Crítico Adultos, Hospital Clínico UC-CHRISTUS, Marcoleta #367, Santiago Centro, RM 8330077, Chile

Full list of author information is available at the end of the article



(Continued from previous page)

Conclusions: Latin American intensivists constitute a predominantly young adult workforce, mostly formally trained, have a high workload, and most are interested in research. They are under important limitations owing to resource constraints and overt dissatisfaction. Latin America may be representative of other world areas with similar challenges for intensivists. Specific initiatives aimed at addressing these situations need to be devised to improve the quality of critical care delivery in Latin America.

Keywords: Intensive care units, Latin American, LMIC, Critical care, Health, Manpower

Background

Intensive care medicine (ICM) is a relatively young discipline that has rapidly grown into a full-fledged specialty. Given the aging of the population, the rising burden of chronic comorbidities, and the complexity of modern medicine, the intensive care unit (ICU) turns out to be the very last healthcare venue for many diseases. Intensivists are responsible for managing the ever-increasing number of patients with complex, life-threatening diseases [1]. Several factors could influence the performance of intensivists, including their age, training, experience, workload, and socioeconomic context. Latin America is a region that comprises mainly middle-income countries and deals with challenges such as poverty, low salaries, and low quality of employment [2]. We think it may well represent other world regions in terms of particular contexts and challenges that intensivists must overcome.

Although the commitment to provide high-quality patient care is firmly grounded in the medical profession, several recent publications have addressed noncompliance with best evidence practice by physicians [3]. This is perhaps most relevant for the treatment of patients with sepsis, a key area in critical care medicine in which several diagnostic and therapeutic approaches have been proposed over the years [4, 5]. To address some of these aspects, we developed a survey with the aim of gaining insight into how Latin American intensivists feel about some predetermined issues related to their daily work and expectations, as well as some aspects regarding the management of septic shock.

Methods

This study was designed, coordinated, and executed by the Latin American Intensive Care Network - LIVEN (www.reddliven.org) [6], which appointed a steering committee and local coordinators in each country.

Design and setting

We conducted a cross-sectional study of intensivists from 11 Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guatemala, Mexico, Paraguay, Peru, and Uruguay). The Pontificia Universidad Católica de Chile was the only coordinating center. The local ethics committee (Comité de Ética Clínica de la Facultad de

Medicina) waived the need for informed consent because survey participation was voluntary; thus, informed consent is assumed.

In May 2016, Latin American intensivists, identified from lists provided by national critical care medicine societies and networks, social networks, and personal contacts, were invited to participate in the survey. One week later, a web-based electronic questionnaire was submitted. Weekly reminders were emailed to nonrespondents from June through September 2016.

Questionnaire development

The survey was designed by a committee that incorporated questions regarding training, workload, competencies, continuing education, research activities, and experiential aspects. The construct was defined on the basis of studies that demonstrated links between individual characteristics of intensivists with clinical performance [7].

After a draft revision by a group of LIVEN investigators, some questions were reformulated, added, or deleted. Content validity was established by independent reviewers who determined whether each question captured the intended domain. After piloting the survey in 4 centers, the final version included 51 items under the following domains: organizational characteristics of the ICU, human resources, professional development, research participation, competencies and skills, satisfaction, and expectations.

We asked some questions about septic shock management because this condition integrates ICU workflow, resource availability, and diverse aspects of critical care provision. We considered that ICUs with appropriate conditions for septic shock care had availability of antibiotics, vasopressors, laboratory tests (arterial blood gases, serum lactate, general blood and biochemistry tests, blood and fluid cultures and microbiology identification), imaging resources, and the possibility to consult different specialists upon request (see full survey as Additional file 1: File S1).

We defined a long or short morning round on the basis of the duration being longer or shorter than 2 h, respectively. We defined a multidisciplinary round as one that, apart from the intensivists, included at least two other professionals (nurses, respiratory therapists, pharmacists, or other specialists).

Data processing and statistical analysis

Data are expressed as mean ± SD or median (IQR), as appropriate. Categorical variables were compared with the chi-square test; continuous variables were analyzed with *t* tests, the Kruskal-Wallis test, and the Wilcoxon rank-sum test, according to their distribution. Logistic regression analysis was performed in a stepwise fashion according to individual covariates’ significance. ORs and 95% CIs were reported.

We investigated the association between country-level factors and relevant outcomes, adjusting for individuals’ characteristics using multilevel multivariable logistic regression. A two-level model was fit with intensivist-level fixed effects at the first level and country-level fixed effects at the second level, as well as a country-specific random effect. Individual-level variables of interest included age, sex, years of experience (collinear with age), weekly working time (in hours), and type of ICU (public/private, academic/nonacademic). We selected variables for the multivariable model using forward and backward stepwise regression. We considered variables for the model if they were associated with outcome with a *p* value less than 0.20 in univariate analysis. Additionally, some variables were introduced to the model because of their clinical relevance, regardless of their *p*

value. We performed subgroup analyses by stratifying intensivists according to their position in the ICU. To choose among the alternative models, we used the likelihood ratio test for testing on the boundary of the parameter space as a measure of the relative predictive ability of a statistical model for a given set of data. Two-tailed *p* values less than 0.05 were considered statistically significant. We conducted all statistical analyses with the use of Stata 14.2 software (StataCorp, College Station, TX, USA).

Results

General

Of the 1380 surveys sent out, we received 735 responses by intensivists from 11 countries, yielding a global response rate of 53%. (See Fig. 1 for country representation.) Sixty percent of intensivists worked in ICUs located in public hospitals (Table 1, Additional file 2: Table S1A), with no statistically significant difference according to their position (Additional file 2: Table S1B). Sixty percent worked in two or more hospitals (Additional file 2: Table S1C, D), and 67% worked in academic hospitals (Table 1, Additional file 2: Table S1A), without any difference in the public/private status of their primary hospital (Additional file 2: Table S1D).

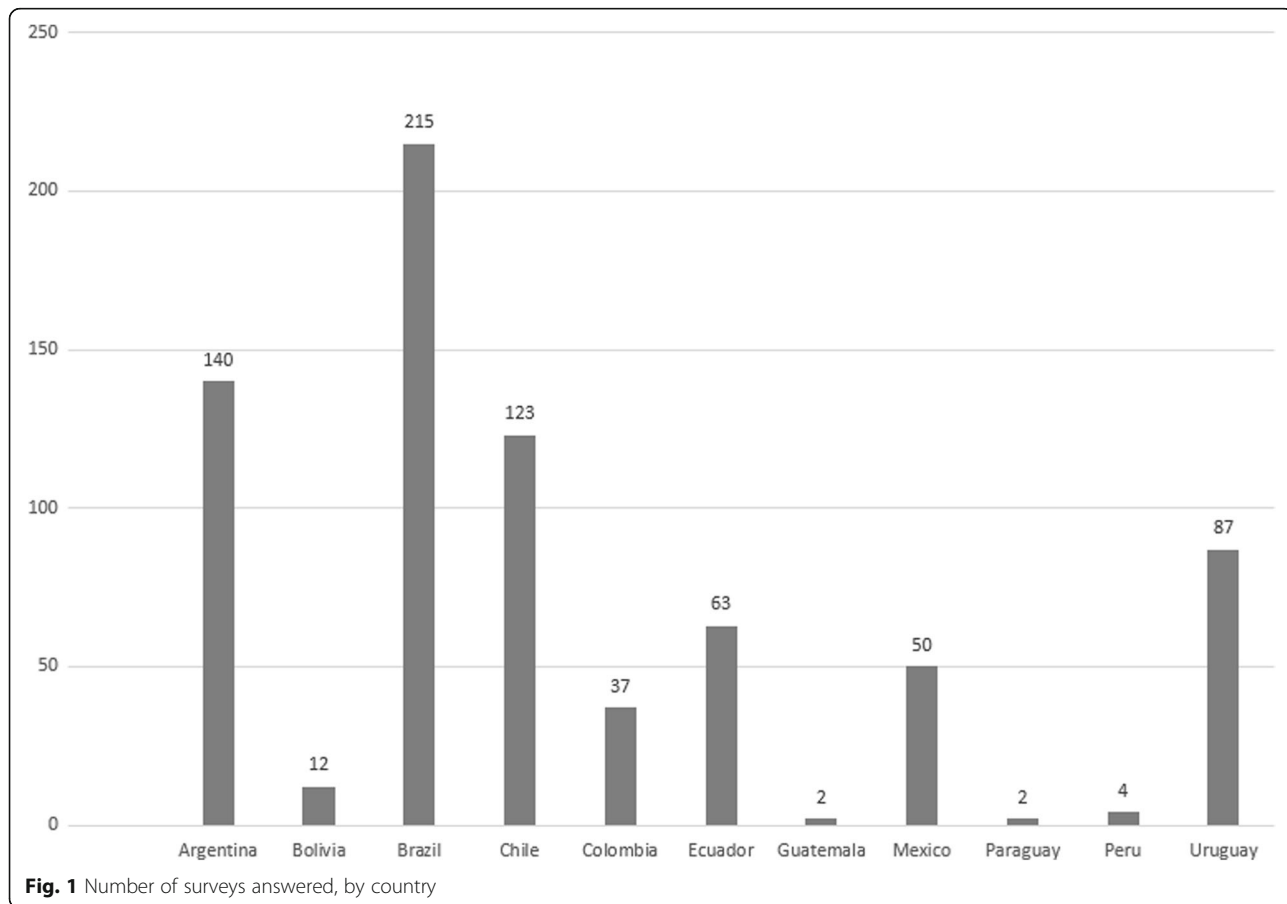


Table 1 General characteristics of study population

Variable	Data
Age, years, median (IQR)	40 (35–48)
Female sex, <i>n</i> (%)	238 (32%)
ICU experience, years, median (IQR)	10 (5–10)
ICU experience, <i>n</i> (%)	
< 10 years	391 (53)
11–20 years	197 (27)
21–30 years	123 (17)
> 30 years	24 (3)
ICU type (public)	440 (60)
ICU type (academic)	494 (67)
Primary specialty, <i>n</i> (%)	
Surgery	15 (2)
Emergency medicine	25 (3)
Anesthesia	31 (4)
Internal medicine only	136 (19)
Internal medicine	199 (27)
Intensive care medicine only	411 (56)
Intensive care medicine	505 (69)
Training, <i>n</i> (%)	
On-the-job training	177 (24)
2-year program	204 (28)
3-year program	152 (21)
4-year program	155 (21)
Other	45 (6)
No training	2 (0)
Reading scientific papers, <i>n</i> (%)	
Daily	43 (6)
1–3/week	346 (50)
1–2/month	305 (44)
Other	41 (6)

The surveyed workforce was composed predominantly of males (68%) and young adults (median age, 40 [35–48] years) (Table 1, Fig. 2a). Fifty-three percent of intensivists had less than 10 years of experience in the ICU, and 20% had more than 20 years (Table 1, Fig. 2b). Residents comprised a minority of the respondents (13%).

ICU training varied among countries, with three different formal academic programs of variable duration (2–4 years) and a work-based assessment of competences without specific duration (Table 1, Additional file 3: Figure S1).

Workload, clinical rounds, and competencies

The median weekly workload was 60 (IQR, 47–70) h, mostly spent in the ICU (Additional file 4: Figure S2),

without differences between academic and nonacademic centers (median 60 [IQR, 46–70] vs. 60 [IQR, 48–68] h; $p = 0.7$). The duration and characteristics of clinical rounds varied widely across countries, with differences between academic and nonacademic units (Fig. 3).

Fifty-two percent of intensivists worked daily and also did night shifts. Twenty-two percent worked only in day shifts, and 22% only in night shifts. The median number of night shifts was 1 (IQR, 1–2) per week. Younger intensivists did more night shifts per week ($p < 0.001$). According to position, staff intensivists performed the higher number of shifts per week (median, 2 [IQR, 1–3]), followed by residents (median, 2 [IQR, 1–2]) ($p < 0.001$). The number of beds covered per intensivist varied from 3 to 12 per night shift. Most ICUs (76%) had consultants available during night shifts. Overall, survey respondents considered themselves very competent to perform many common procedures. There were significant differences according to position, age, and years of experience in the ICU (Table 2).

Septic shock management

Most intensivists (85%) reported adequate conditions to manage patients with septic shock. However, perception of satisfactory conditions was lower in ICUs located in public hospitals (OR, 0.36 [0.26–0.47]; $p < 0.001$) and in nonacademic ICUs (OR, 0.48 [0.35–0.65]; $p < 0.001$). The main reasons for dissatisfaction were attributed to insufficient technology (11%), laboratory support (5%), imaging resources (5%), and limited drug availability (5%). Lactate could be measured by 90% of intensivists, but at a variable time, depending on ICU type (Additional file 5: Table S2A). A computed tomographic (CT) scan was available within < 2 h in 54% of ICUs and within < 6 h in 81% of ICUs, with variations according to ICU type (Additional file 5: Table S2B). In all countries, ICUs located in private hospitals had significantly greater availability of CT scanners compared with ICUs belonging to the public health sector (68% vs 49% in < 2 h; OR, 3.13 [2.02–5.94]; $p < 0.001$).

Education and research

The Internet was widely accessible (91%). Most Latin American intensivists used online resources to improve their scientific knowledge (96%). More than half of the intensivists surveyed (54%) read scientific studies regularly, daily, or two or three times per week (Table 2), whereas 32% read no more than one scientific study per month. These results were similar for academic and nonacademic ICUs ($p = 0.6$). Seventy-five percent of respondents had attended at least one scientific meeting in the past year, and 88% had taken a refresher course. Seventy-six percent reported having “some” or “much” institutional support, but 24% responded that they had “minimal” or

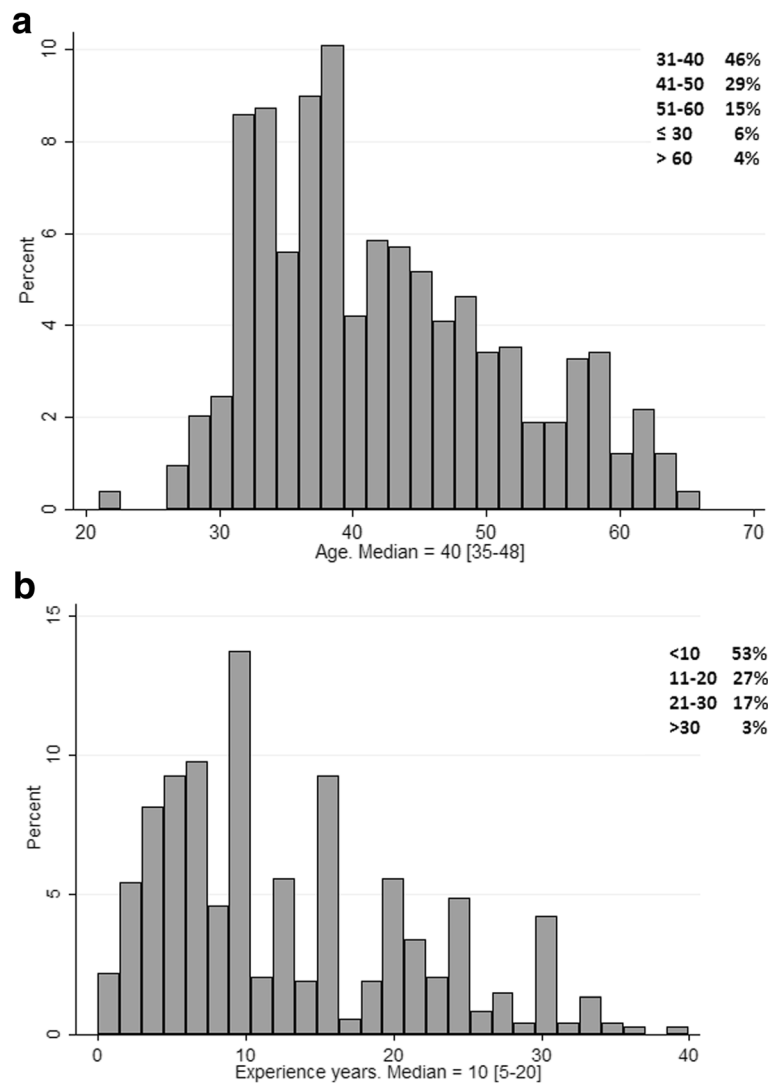


Fig. 2 a Distribution of Latin American intensivists according to age. **b** Distribution of Latin American intensivists according to years of intensive care unit experience

“no support” from their hospitals to participate in these meetings. Financial and permission restrictions were the main reasons (Table 3).

Seventy percent of the respondents participated in research activities, mostly in academic settings (71%). Working in a nonacademic ICU and being a resident were associated with less probability of doing research (OR, 0.50 [0.36–0.73]; and OR, 0.36 [0.23–0.58], respectively; $p < 0.001$ for both). Conversely, being male was associated with higher probability of doing research (OR, 1.52 [1.08–2.15]; $p = 0.017$). Most of the funding came from intensivists’ respective institutions (39%) or was self-provided (19%), whereas 14% of intensivists declared no specific research funding. Research grants and pharmaceutical sponsorship were rarely available (9% and 7%, respectively). Most of the research was published in peer-reviewed journals (63%).

Perceptions and expectations

Environmental conditions (private restrooms, comfortable bedrooms for rest or sleep) during night shifts were reported as inappropriate in 62% of the respondents, especially by female intensivists (71% vs. 60%; $p < 0.001$). A minority of intensivists were satisfied with their personal income (19%). It was higher in male than in female physicians (22% vs 13%; OR, 1.84 [1.17–2.91]; $p = 0.009$). On the contrary, higher weekly workload (OR, 0.98 [0.97–0.99]; $p = 0.017$) and a higher number of night shifts (OR, 0.80 [0.67–0.96]; $p = 0.007$) were associated with lower income satisfaction. Overall, a minority of intensivists (27%) reported having considered quitting their job as intensivists, mostly in Argentina (41%) and Brazil (36%). Fifty-five percent on the Latin American intensivists intended to leave ICU practice before retirement.

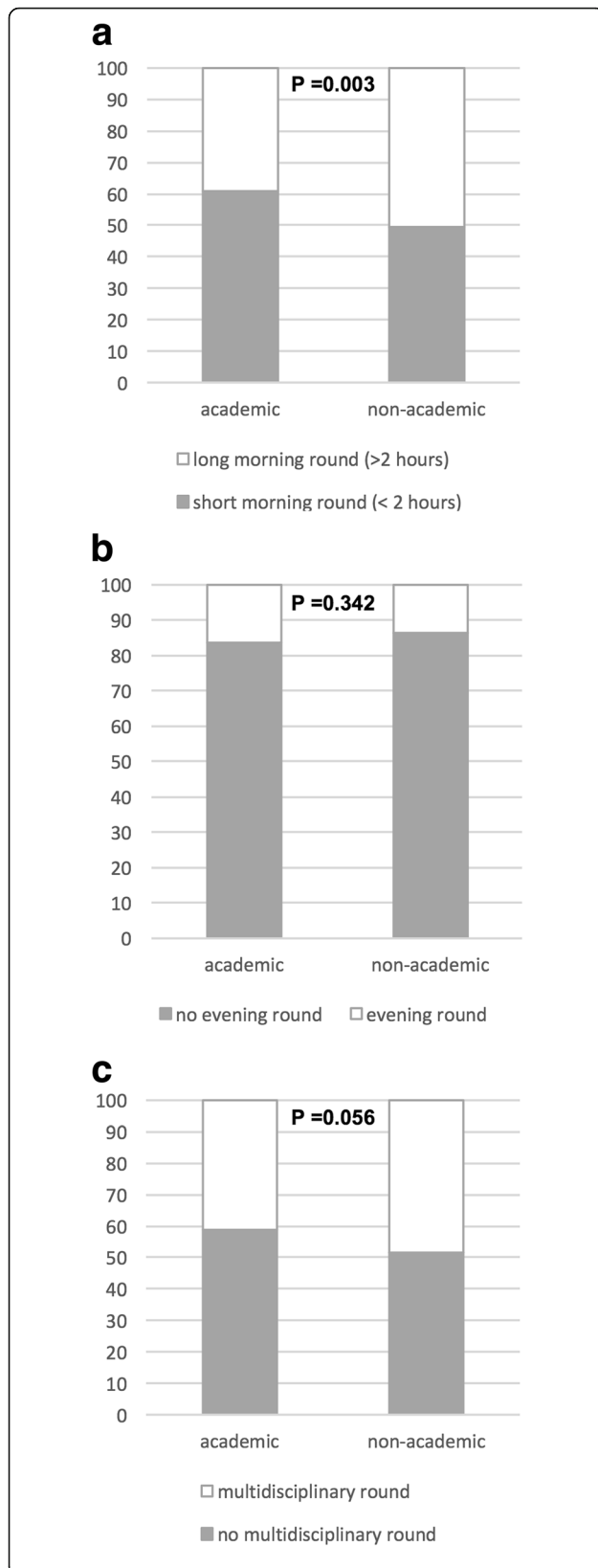


Fig. 3 Proportion of intensive care unit rounds according to their academic status and (a) length of morning round, (b) presence of evening round, and (c) number of specialists involved in the morning round

Discussion

This is the first study in Latin America involving evaluation of individual- and work-related aspects of the intensivist workforce. Our main findings were that the intensivist workforce of the region, mostly related to academic centers, is predominantly young, has been formally trained, report adequate procedural skills, and operates under high workloads and restrictions owing to resource constraints and local limitations. Although there is no ideal percentage, a higher response rate to our questionnaire would have been desirable. However, our first survey (LIVEN-1) had a similar return rate (52%) [6], which is in line with the declining response rates to surveys over the years [8, 9].

Health systems vary across Latin American countries, and a mix of public and private ICUs do exist, sometimes with uneven resource distribution [10, 11]. In our study, most intensivists worked primarily in public hospitals, but less than half worked in only one hospital. This could have an impact in terms of costs and efficiency because working in more than one hospital might result in higher costs owing to “work dispersion” [12].

Our respondents reported having mostly formal ICM training (70%), mainly under the supraspecialty model, which considers training in a base specialty followed by a common ICM program. This was also the most frequent training mechanism in a 41-country survey published some time ago [13]. Other mechanisms, such as the assessment of competencies, are common in Chile and Brazil, perhaps in response to the shortage of intensivists [14, 15].

With regard to workload, working more than 60 h per week was associated with a high level of burnout in a recent study [16]. Intention to leave is a known predictor of burnout [17, 18], as well. Because 60 h was the median weekly workload of our respondents and more than half of them reported their desire to leave the ICU before retirement, Latin American academic intensivists probably experience high-level burnout. Along the same line, a recent study of ICM training program directors showed that higher workload correlated with negative self-perception about the teaching role, patient care, and job stability [19]. In addition, the number of night shifts has clearly been associated with burnout among pediatric intensivists [20] and critical care nurses [21]. In our survey, staff physicians reported a higher night shift load and higher intention to leave, an association described previously [20, 21]. These findings call for responsible authorities to be concerned about intensivists’ workload and mental health.

Table 2 Self-reported confidence in competency to perform clinical duties, according to intensivist position, age, and years of experience

Procedure		ICU director	Medical coordinator	Staff physicians	Residents	Shift physicians	Other	Overall	p Value
Intensivists by position									
Intubation	Yes	122 (98)	104 (100)	362 (100)	91 (95)	35 (100)	12 (92)	726 (99)	<0.001
	No	2 (2)	0 (0)	0 (0)	5 (5)	0 (0)	1 (8)	8 (1)	
Central venous catheter insertion	Yes	124 (100)	104 (100)	359 (99)	92 (96)	35 (100)	12 (92)	726 (99)	0.005
	No	0 (0)	0 (0)	3 (1)	4 (4)	0 (0)	1 (8)	8 (1)	
Arterial line insertion	Yes	120 (97)	103 (99)	350 (97)	89 (93)	35 (100)	10 (77)	707 (96)	0.001
	No	4 (3)	1 (1)	12 (3)	7 (7)	0 (0)	3 (23)	27 (4)	
PA catheter placement	Yes	111 (90)	90 (87)	290 (80)	66 (69)	26 (74)	7 (54)	590 (80)	<0.001
	No	13 (10)	14 (14)	72 (20)	30 (31)	9 (26)	6 (46)	144 (20)	
Echocardiography	Yes	53 (43)	43 (41)	149 (41)	42 (44)	11 (31)	3 (23)	301 (41)	0.621
	No	71 (57)	61 (59)	213 (59)	54 (56)	24 (69)	10 (77)	433 (59)	
End-of-life care issues management	Yes	122 (98)	101 (97)	337 (93)	78 (81)	30 (86)	10 (77)	678 (92)	<0.001
	No	2 (2)	3 (3)	25 (7)	18 (19)	5 (14)	3 (23)	56 (8)	
Intensivists by age									
Intubation	Yes	45 (41–51)	44 (38–52)	39 (35–46)	33 (31–38)	40 (35–53)	39 (37–46)	40 (35–48)	<0.001
	No	52 (41–63)	–	–	31 (31–33)	–	31 (31–31)	32 (31–39)	0.202
Central venous catheter insertion	Yes	45 (41–51)	44 (38–52)	39 (35–46)	33 (31–38)	40 (35–53)	39 (37–46)	40 (35–48)	<0.001
	No	–	–	34 (29–37)	32 (31–35)	–	31 (31–31)	32 (31–35)	0.513
Arterial line insertion	Yes	45 (41–51)	44 (38–52)	39 (35–46)	33 (31–38)	40 (35–53)	38 (37–47)	40 (35–48)	<0.001
	No	49 (44–54)	47 (47–47)	36 (33–53)	32 (30–33)	–	39 (31–42)	35 (32–47)	<0.001
PA catheter placement	Yes	45 (41–51)	43 (38–51)	40 (35–47)	34 (31–39)	41 (34–53)	44 (37–48)	41 (35–49)	<0.001
	No	44 (41–60)	45 (39–52)	36 (33–42)	32 (29–34)	40 (39–45)	35 (32–39)	37 (32–45)	<0.001
Echocardiography	Yes	46 (40–51)	39 (37–48)	38 (34–44)	34 (31–37)	39 (38–40)	39 (37–39)	39 (34–45)	<0.001
	No	45 (42–52)	47 (41–54)	40 (35–49)	33 (31–38)	45 (34–53)	40 (33–47)	42 (35–50)	<0.001
End-of-life care issues management	Yes	46 (41–51)	45 (38–52)	39 (35–46)	33 (31–38)	42 (38–53)	41 (37–47)	40 (35–49)	<0.001
	No	39 (36–41)	38 (37–41)	38 (35–42)	31 (30–37)	37 (33–44)	33 (31–37)	36 (31–41)	0.092
Intensivists by years of experience									
Intubation	Yes	16 (10–23)	15 (10–24)	10 (5–16)	4 (2–6)	12 (7–20)	10 (5–12)	10 (6–20)	<0.0001
	No	22 (9–34)	–	–	2 (2–4)	–	2 (2–2)	3 (2–8)	0.1193
Central venous catheter insertion	Yes	16 (10–23)	15 (10–24)	10 (5–17)	4 (2–6)	12 (7–20)	10 (5–12)	10 (6–20)	<0.0001
	No	–	–	2 (1–7)	2 (1–4)	–	2 (2–2)	2 (2–4)	0.9463
Arterial line insertion	Yes	15 (10–23)	15 (10–24)	10 (6–16)	4 (2–6)	12 (7–20)	10 (5–10)	10 (6–20)	<0.0001
	No	21 (18–24)	12 (12–12)	6 (2–19)	2 (1–6)	–	5 (2–14)	3 (2–16)	0.0315
PA catheter placement	Yes	16 (10–23)	15 (10–24)	10 (6–20)	5 (2–7)	12 (6–21)	10 (10–14)	11 (6–20)	<0.0001
	No	12 (9–27)	12 (11–22)	7 (4–10)	2 (1–5)	12 (9–12)	5 (4–8)	7 (4–12)	<0.0001
Echocardiography	Yes	15 (10–22)	10 (9–16)	9 (5–15)	4 (2–6)	10 (6–12)	8 (5–14)	10 (5–16)	<0.0001
	No	16 (10–24)	20 (12–25)	10 (6–20)	3 (2–5)	14 (8–22)	10 (5–10)	11 (6–20)	<0.0001
End-of-life care issues management	Yes	16 (10–23)	15 (10–24)	10 (6–18)	4 (2–6)	12 (7–20)	10 (5–14)	16 (10–20)	<0.0001
	No	9 (8–10)	10 (8–10)	5 (5–12)	2 (1–6)	10 (8–14)	4 (2–8)	5 (2–10)	0.0106

ICU Intensive care unit, PA Pulmonary artery

p Values for intensivists by position are for yes/no proportions. Age and years of experience are expressed as median (IQR)

Table 3 Institutional restrictions on attending scientific meetings in participating countries

Restrictions	No.			%	
Some	262			36	
Much	299			41	
None	72			10	
Few	102			14	
Total	735			100	
Country	Financial restrictions	Permission restrictions	Time restrictions	Other	Total
Argentina	66 (68)	18 (19)	11 (11)	2 (2)	97 (100)
Bolivia	4 (36)	6 (55)	1 (9)	0 (0)	11 (100)
Brazil	49 (36)	58 (44)	0 (0)	26 (20)	133 (100)
Chile	14 (25)	39 (70)	2 (4)	1 (2)	56 (100)
Colombia	8 (35)	13 (57)	2 (9)	0 (0)	23 (100)
Ecuador	23 (40)	33 (57)	1 (2)	1 (2)	58 (100)
Guatemala	2 (100)	0 (0)	0 (0)	0 (0)	2 (100)
Mexico	8 (24)	23 (70)	2 (6)	0 (0)	33 (100)
Paraguay	0 (0)	1 (100)	0 (0)	0 (0)	1 (100)
Peru	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)
Uruguay	28 (49)	19 (33)	9 (16)	1 (2)	57 (100)
Overall n (%)	203 (43)	210 (45)	28 (5)	31 (7)	472 (100)

Permission restrictions refer to nonauthorization to attend a meeting owing to managerial reasons

Our finding that short and non-multidisciplinary morning rounds occur mainly in academic ICUs, unveiling the tensions that academic intensivists may experience in performing high-quality clinical work in time- and resource-restricted contexts. Conversely, those in many nonacademic ICUs performed long morning rounds, a fact not easily reconciled with the previous one. Academic medical centers share a mission of patient care, teaching, and research [22], but financial pressures might promote the former to the detriment of teaching and research [22] despite the “academic” denomination [23]. This could be happening in Latin America, where financial challenges [2] compete with education at all levels.

Procedural complications are a significant cause of inpatient morbidity and mortality in the ICU [24]. In our surveyed population, self-perception of technical skills was high, especially among older and more experienced doctors. Residents tended to exhibit lower self-confidence in most procedures, but they were a minority. Our results reflect the well-known progression in skill levels after training and years of experience [25].

Regarding septic shock management, some intensivists reported insufficient conditions to treat it adequately, mentioning drug shortages, among other reasons. Increased mortality has been observed during shortages of drugs in low-income [26, 27] and high-income countries [28]. High mortality of sepsis and septic shock reported in Latin America [27, 29] could be partially explained by this.

Additionally, we considered CT scans and lactate measurements as proxies for clinical workflow and resource availability. Lactate measurement availability was acceptable overall, with some differences in public vs private hospitals. On the contrary, in private ICUs, CT scanners were much more accessible. In fact, although we did not study the relationship of these resources with any outcomes, it has been demonstrated that resource inequality is a determinant of quality of care [30] and health outcomes in the ICU [31, 32], especially in resource-poor settings.

Latin American intensivists preferred online resources as the source of scientific information, similar to U.S. physicians [33]. Among our respondents, the rate of reading scientific studies was lower than reported in other studies [34]. Because ICU academic status was not a determinant for scientific reading, knowledge acquisition seems to rely on personal interests. Most intensivists would have attended scientific meetings outside their hospitals, but they were hindered by financial and permission restrictions. This contrasts with a study involving physicians from high-income countries [35], in which researchers reported attendance at a considerable number of meetings each year. The same study showed that congresses and conferences are preferred, which is similar to our results.

Barriers to participation in clinical research in developing countries are widely known [36]. Two-thirds of surveyed physicians showed interest in research and

published some work in a peer-reviewed journal. A study on physicians from different specialties, excluding intensivists, yielded similar results, showing that 63% of them had published articles in medical journals [34]. Our reported participation in research is high, probably owing to the academic connections of our respondents.

End-of-life care is an area of increasing prominence in the ICU [37], but studies have shown that, for example, appropriate relief of suffering and pain in dying patients is dissimilar in ICUs [38]. In this field, Latin America presents regional shortcomings related to inadequate legislation, insufficient infrastructure, lack of opportunities for clinical training, unreliable reporting of data, and cultural barriers [39]. Younger intensivists reported lower confidence than their older and more experienced colleagues in addressing these issues. A leveraging agenda must be developed to provide all intensivists with the competencies required to address these patients' needs properly.

Job satisfaction is a multidomain perception related to many factors [40]. We did not address it specifically but instead asked about income, which has been related to general and emotional well-being as well as job satisfaction [40, 41]. In our study, most respondents considered their income unsatisfactory, especially female and middle-aged physicians. In a recent study in Latin America, being female was associated with lower job satisfaction as well as higher workload [42]. How these issues interact with the expectations, rewards, and drawbacks of working as an intensivist still need to be more completely elucidated.

Our study has several limitations. The results are not generalizable to all Latin American countries. This study was performed with a convenience sample of physicians working in Latin American ICUs, predominantly academic, with respondents probably more prone to read scientific literature and to conduct research. The heading of the survey questions asked that respondents answer thinking about the ICU where they work most hours per week, but undoubtedly this could have introduced bias. We did not interrogate for burnout, moral distress, specific end-of-life care issues, or communication and management skills. In-training physicians were underrepresented in this sample, as were physicians working in ICUs without board certification. Regardless of these considerations, in the absence of previous information, this is the first description of general, individual, and work-related characteristics of the intensivist workforce in Latin America, mainly at academic ICUs.

Conclusions

Latin American intensivists are still a young adult group of physicians with unique problems that include a high weekly workload, important resource constraints, job dissatisfaction, and financial limitations on and barriers to attending educational opportunities.

Many challenges remain unsettled in terms of training and competencies to develop, as well as how to achieve workload balance. Some of the issues described may help to depict the panorama of the delivery of critical care around the world.

Additional files

Additional file 1: File S1. LIVEN SHOCK II- Physicians Survey. (PDF 339 kb)

Additional file 2: Table S1. Distribution of: (A) academic vs non-academic ICUs according to their public or private status, (B) ICU condition (public/private) where intensivists work, by role, (C) number of ICUs where intensivists work by role, and (D) number of different ICU where intensivists work according to public or private intensivists' primary hospital. (DOCX 87 kb)

Additional file 3: Table S2. Intensive care medicine training programs duration in LIVEN-2 respondents according to country. (TIFF 6093 kb)

Additional file 4: Figure S1. Proportion of weekly workload spent in the ICU versus non-ICU work of LIVEN-2 respondents according to country. (TIFF 6207 kb)

Additional file 5: Figure S2. Availability of: (A) lactate and (B) CT-scan, according to ICU-type and time. (DOCX 59 kb)

Abbreviations

CT: Computed tomographic; ICM: Intensive care medicine; ICU: Intensive care unit; LIVEN: Latin American Intensive Care Network; PA: Pulmonary artery

Acknowledgements

We are fully indebted to all respondents and to the critical care societies of Latin America, as well as to the Brazilian Research in Intensive Care Network (BRICNET) and AMIBNet, which endorsed the study in Brazil.

Funding

This study was performed with no specific funding.

Availability of data and materials

The datasets used and/or analyzed during the present study are available from the corresponding author on reasonable request.

Authors' contributions

RC was responsible for study design, literature search, data interpretation, tables, figures, statistical and data analysis, and manuscript writing. NNV was responsible for study design, data collection, and data analysis. FR was responsible for study design, data collection, and data analysis. LA was responsible for study design, survey distribution, data collection, and manuscript writing. EE was responsible for data collection, data analysis, and manuscript writing. GM was responsible for data collection. GF was responsible for data collection. MJ was responsible for data collection. GOT was responsible for data collection. JH was responsible for data collection. MM was responsible for data collection. FRM was responsible for data collection. AC was responsible for data collection and data analysis. AD was responsible for data collection. LA was responsible for data collection and data interpretation. MC was responsible for data collection and data interpretation. JB was responsible for data analysis, data interpretation, and manuscript writing. GH was responsible for study design, data interpretation, and manuscript writing. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Pontificia Universidad Católica de Chile was the only coordinating center. For this survey, the local ethics committee (Comité de Ética Clínica de la Facultad de Medicina de la Pontificia Universidad Católica de Chile) approved its content and waived the need for informed consent because physicians' survey participation was voluntary, informed consent was assumed, and no patients were involved in this study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details

¹Departamento de Medicina Intensiva, Facultad de Medicina, Pontificia Universidad Católica de Chile, Diagonal Paraguay #362, Santiago Centro, RM 8330077, Chile. ²Hospital Español, Avenida General Garibaldi, 1729 esq., Rocha, Montevideo, Uruguay. ³Agencia Nacional de Investigación e Innovación (ANII), Montevideo, Uruguay. ⁴Servicio de Terapia Intensiva, Hospital Alejandro Posadas, Avenida Presidente Arturo U. Illia, El Palomar, Buenos Aires, Argentina. ⁵Servicio de Terapia Intensiva, Hospital Interzonal de Agudos General San Martín de La Plata, Avenida 1 1794, Casco Urbano, La Plata, Buenos Aires B1904CFU, Argentina. ⁶Clinica Bazterrica and Clínica Santa Isabel, Billingham 2072 (esquina Juncal), Ciudad Autónoma de Buenos Aires, Argentina. ⁷Departamento de Medicina Interna - Faculdade de Medicina, Universidade Federal do Rio Grande do Sul, Hospital de Clínicas de Porto Alegre, Rua Ramiro Barcelos, 2350 - Santa Cecília, Porto Alegre, RS 90035-903, Brasil. ⁸Escuela de Medicina, Universidad Internacional del Ecuador, Unidad de Cuidados Intensivos, Hospital Eugenio Espejo, Avenida Gran Colombia, Quito 170136, Ecuador. ⁹Department of Intensive Care Medicine, Fundación Valle del Lili - Universidad ICESI, Cali, Carrera 98 No. 18-49, Cali, Valle del Cauca, Colombia. ¹⁰Unidad de Cuidados Intensivos, Hospital Regional 1 Octubre, ISSSTE, Avenida Instituto Politécnico Nacional 1669, Colonia Lindavista, c.p., Delegación Gustavo A. Madero, Ciudad de México 07300, México. ¹¹Anesthesiology, Pain and Intensive Care Department, Federal University of São Paulo, Rua Sena Madureira, 1500 - Clementino, São Paulo, SP 04021-001, Brasil. ¹²Research Institute HCor, Hospital do Coração, Rua. Desembargador Eliseu Guilherme, 147 - Paraíso, São Paulo, SP 04004-030, Brasil. ¹³Catedra de Farmacología, Facultad de Ciencias Médicas, Universidad Nacional de La Plata, Buenos Aires, Argentina. ¹⁴Servicio de Terapia Intensiva, Sanatorio Otamendi y Miroli, Azcuénaga 894, CABA C1115AAB, Argentina. ¹⁵Anesthesiology, Pain and Intensive Care Department, Federal University of São Paulo, São Paulo, Brazil. ¹⁶Emergency Medicine Department, University of São Paulo, Hospital Sirio-Libanes, Rua Dona Adma Jafet, 91 - Vista, São Paulo, SP 01308-050, Brasil. ¹⁷St. George's University Hospitals NHS Foundation Trust, London SW17 0QT, UK. ¹⁸Division of Pulmonary, Allergy, and Critical Care Medicine, Columbia University Medical Center, 630 West 168th Street, New York, NY 10032, USA. ¹⁹Unidad de Paciente Crítico Adultos, Hospital Clínico UC-CHRISTUS, Marcoleta #367, Santiago Centro, RM 8330077, Chile.

Received: 13 July 2017 Accepted: 16 January 2018

Published online: 21 February 2018

References

- Vincent JL, Singer M, Marini JJ, Moreno R, Levy M, Matthay MA, Pinsky M, Rhodes A, Ferguson ND, Evans T, Annane D, Hall JB. Thirty years of critical care medicine. *Crit Care*. 2010;14:311.
- Maso A. What challenges will Latin America face in 2016? Washington, DC: World Bank; 2016. <https://www.worldbank.org/en/news/feature/2016/01/04/2016-desafios-latinoamerica>. Accessed 10 Jun 2017.
- Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. 1999;282:1458-65.
- Cecconi M, De Backer D, Antonelli M, Beale R, Bakker J, Hofer C, Jaeschke R, Mebazaa A, Pinsky MR, Teboul JL, Vincent JL, Rhodes A. Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine. *Intensive Care Med*. 2014;40:1795-815.
- Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, Ferrer R, Kumar A, Sevransky JE, Sprung CL, Nunnally ME, Rochwerg B, Rubenfeld GD, Angus DC, Annane D, Beale RJ, Bellomo R, Bernard GR, Chiche JD, Cooper DJ, De Backer DP, French CJ, Fujishima S, Gerlach H, Hidalgo JL, Hollenberg SM, Jones AE, Karnad DR, Kleinpell RM, Koh Y, Lisboa TC, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. *Crit Care Med*. 2017;45:486-552.
- Estenssoro E, Alegría L, Murias G, Friedman G, Castro R, Nin Vaeza N, Loudet C, Bruhn A, Jibaja M, Ospina-Tascon G, Rios F, Machado FR, Biasi Cavalcanti A, Dubin A, Hurtado FJ, Briva A, Romero C, Bugedo G, Bakker J, Cecconi M, Azevedo L, Hernandez G. Latin-American Intensive Care Network (LIVEN). Organizational issues, structure, and processes of care in 257 ICUs in Latin America: a study from the Latin America Intensive Care Network. *Crit Care Med*. 2017;45:1325-36.
- Garland A, Shaman Z, Baron J, Connors Jr AF. Physician-attributable differences in intensive care unit costs. *Am J Respir Crit Care Med*. 2006;174:1206-10.
- Hardigan PC, Popovici I, Carvajal MJ. Response rate, response time, and economic costs of survey research: a randomized trial of practicing pharmacists. *Res Social Adm Pharm*. 2016;12:141-8.
- American Association for Public Opinion Research (AAPOR). Standard definitions: final dispositions of case codes and outcome rates for surveys. 9th ed. Oakbrook Terrace, IL: AAPOR 2016 http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf. Accessed 29 Jan 2018.
- Ruiz GO, Castell CD. Epidemiology of severe infections in Latin American intensive care units. *Rev Bras Ter Intensiva*. 2016;28:261-3.
- Amorim FF, Santana AR, Biondi RS, Amorim AP, Moura EB, Quadros KJ, Oliveira HS, Ribeiro RA. Difference in patient outcomes coming from public and private hospitals in an intensive care unit in Brazil. *J Clin Med Res*. 2012;4:410-4.
- Miller ME, Welch WP, Welch HG. The impact of practicing in multiple hospitals on physician profiles. *Med Care*. 1996;34:455-62.
- Barrett H, Bion JF. An international survey of training in adult intensive care medicine. *Intensive Care Med*. 2005;31:553-61.
- Obregón Castro P. Faltan 502 camas UCI y UTI para paliar déficit, un tercio de la actual capacidad. *Economía y Negocios*. 30 Dec 2012. <http://www.economiaynegocios.cl/noticias/noticias.asp?id=104325>. Accessed 29 Jan 2018.
- de Souza A; Secretaria de Gestão do Trabalho e da Educação na Saúde. Brazil's "More Doctors for Brazil" program aims to address the country's physician shortage through the contracting of foreign doctors. *Black Women of Brazil*. 5 Sept 2013. <https://blackwomenofbrazil.co/2013/09/05/brazils-more-doctors-for-brazil-program-aims-to-address-the-countrys-physician-shortage-through-the-contracting-of-foreign-doctors/>. Accessed 29 Jan 2018.
- Embríaco N, Azoulay E, Barrau K, Kentish N, Pochard F, Loundou A, Papazian L. High level of burnout in intensivists. *Am J Respir Crit Care Med*. 2007;175:686-92.
- Weisberg J. Measuring workers' burnout and intention to leave. *Int J Manpower*. 1994;15:4-14.
- Williams ES, Konrad TR, Scheckler WE. Understanding physicians: intentions to withdraw from practice: the role of job satisfaction, job stress, mental and physical health. *Health Care Manage Rev*. 2001;26:7-19.
- Ward NS, Read R, Afessa B, Kahn JM. Perceived effects of attending physician workload in academic medical intensive care units: a national survey of training program directors. *Crit Care Med*. 2012;40:400-5.
- Galván ME, Vassallo JC, Rodríguez SP. Professional burnout in pediatric intensive care units in Argentina. *Arch Argent Pediatr*. 2012; 110:466-73.
- Dall'Ora C, Griffiths P, Ball J, Simon M, Aiken LH. Association of 12 h shifts and nurses' job satisfaction, burnout and intention to leave: findings from a cross-sectional study of 12 European countries. *BMJ Open*. 2015;5:e008331.
- Health Research Institute; PricewaterhouseCoopers. The future of the academic medical center: strategies to avoid a margin meltdown. Feb 2012. http://www.aahcdc.org/Portals/41/AIM-Program/Best-Practices/Financial_Alignment_The_Future_of_the_Academic_Medical_Center_Strategies_to_Avoid_Margin_Meltdown.pdf. Accessed 29 Jan 2018.
- Cohen JJ, Siegel EK. Academic medical centers and medical research: the challenges ahead. *JAMA*. 2005;294:1367-72.
- Rothschild JM, Landrigan CP, Cronin JW, Kaushal R, Lockley SW, Burdick E, Stone PH, Lilly CM, Katz JT, Czeisler CA, Bates DW. The Critical Care Safety Study: the incidence and nature of adverse events and serious medical errors in intensive care. *Crit Care Med*. 2005;33:1694-700.
- Roux D, Reignier J, Thiery G, Boyer A, Hayon J, Souweine B, Papazian L, Mercat A, Bernardin G, Combes A, Chiche JD, Diehl JL, du Cheyron D, L'her E, Perrotin D, Schneider F, Thuong M, Wolff M, Zeni F, Dreyfuss D, Ricard JD. Acquiring procedural skills in ICUs: a prospective multicenter study. *Crit Care Med*. 2014;42:886-95.
- Bataar O, Lundeg G, Tsenddorj G, Jochberger S, Grander W, Baelani I, Wilson I, Baker T, Dünser MW. Helfen Berührt Study Team. Nationwide survey on resource availability for implementing current sepsis guidelines in Mongolia. *Bull World Health Organ*. 2010;88:839-46.
- Dünser MW, Baelani I, Ganbold L. A review and analysis of intensive care medicine in the least developed countries. *Crit Care Med*. 2006;34:1234-42.

28. Vail E, Gershengorn HB, Hua M, Walkey AJ, Rubenfeld G, Wunsch H. Association between US norepinephrine shortage and mortality among patients with septic shock. *JAMA*. 2017;317:1433–42.
29. Vincent JL, Rello J, Marshall J, Silva E, Anzueto A, Martin CD, Moreno R, Lipman J, Gomersall C, Sakr Y, Reinhart K, EPIC II Group of Investigators. International study of the prevalence and outcomes of infection in intensive care units. *JAMA*. 2009;302:2323–9.
30. Babones SJ. Income inequality and population health: correlation and causality. *Soc Sci Med*. 2008;66:1614–26.
31. Schultz MJ, Dünser MW, Dondorp AM, Adhikari NKJ, Iyer S, Kwizera A, Lubell Y, Papali A, Pisani L, Riviello BD, Angus DC, Azevedo LC, Baker T, Diaz JV, Festic E, Haniffa R, Jawa R, Jacob ST, Kissoon N, Lodha R, Martin-Loeches I, Lundeg G, Misango D, Mer M, Mohanty S, Murthy S, Musa N, Nakibuuka J, Neto AS, Hoang MNT, et al. Current challenges in the management of sepsis in ICUs in resource-poor settings and suggestions for the future. *Intensive Care Med*. 2017;43:612–24.
32. Machado FR, Cavalcanti AB, Bozza F, Angus DC, Ferreira EM, Carrara F, Lubarino J, Salomao R, de Azevedo LC P, SPREAD investigators. Epidemiology of sepsis in Brazilian ICUs: a nationwide stratified sample [abstract]. *Intensive Care Med Exp*. 2015;3 Suppl 1:A642.
33. Saint S, Christakis DA, Saha S, Elmore JG, Welsh DE, Baker P, Koepsell TD. Journal reading habits of internists. *J Gen Intern Med*. 2000;15:881–4.
34. Khaliq MF, Noorani MM, Siddiqui UA, Anwar M. Physicians reading and writing practices: a cross-sectional study from Civil Hospital, Karachi, Pakistan. *BMC Med Inform Decis Mak*. 2012;12:76.
35. American Express Global Business Travel. Doctor's orders: What physicians really want from events. 2016. <https://www.amexglobalbusinesstravel.com/content/uploads/sites/4/2017/09/DoctorsOrdersStudyJune2016.pdf>. Accessed 29 Jan 2018.
36. Rahman S, Majumder MA, Shaban SF, Rahman N, Ahmed M, Abdulrahman KB, D'Souza UJ. Physician participation in clinical research and trials: issues and approaches. *Adv Med Educ Pract*. 2011;2:85–93.
37. Truog RD, Campbell ML, Curtis JR, Haas CE, Luce JM, Rubenfeld GD, Rushton CH, Kaufman DC, American Academy of Critical Care Medicine. Recommendations for end-of-life care in the intensive care unit: a consensus statement by the American College of Critical Care Medicine. *Crit Care Med*. 2008;36:953–63.
38. Sprung CL, Cohen SL, Sjøkvist P, Baras M, Bulow HH, Hovilehto S, Ledoux D, Lippert A, Maia P, Phelan D, Schobersberger W, Wennberg E, Woodcock T, Ethicus Study Group. End-of-life practices in European intensive care units: the Ethicus Study. *JAMA*. 2003;290:790–7.
39. Soto-Perez-de-Celis E, Chavarri-Guerra Y, Pastrana T, Ruiz-Mendoza R, Bukowski A, Goss PE. End-of-life care in Latin America. *J Glob Oncol*. 2017;3:261–70.
40. Kahneman D, Deaton A. High income improves evaluation of life but not emotional well-being. *Proc Natl Acad Sci U S A*. 2010;107:16489–93.
41. Leigh JP, Tancredi DJ, Kravitz RL. Physician career satisfaction within specialties. *BMC Health Serv Res*. 2009;9:927.
42. Nassar Junior AP, Pontes de Azevedo LC. Factors associated with job and personal satisfaction in adult Brazilian intensivists. *Rev Bras Ter Intensiva*. 2016;28:107–13.

Submit your next manuscript to BioMed Central and we will help you at every step:

- We accept pre-submission inquiries
- Our selector tool helps you to find the most relevant journal
- We provide round the clock customer support
- Convenient online submission
- Thorough peer review
- Inclusion in PubMed and all major indexing services
- Maximum visibility for your research

Submit your manuscript at
www.biomedcentral.com/submit

