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**Structural features shared by ICUs belonging to research networks  
An international survey.**

**“Critical care research network survey”**

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On the behalf of the Health Services and Research Section of the European Society of Intensive Care Medicine (ESICM) and the “Critical care research network survey” collaboration Group (AMIBNet, ANZICS, ASDI, AZURéa, CCCTG, CCCCTG, BRICNet, CUB–Réa, ECCRN, EDUSepsis, GiVITI, InFACT group, NICE, OUTCOMERéa, PROSAFE, REVA, SCCTG, SEPNET, USCIITG)

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Word count:

1 **Abstract**

2 **Purpose:** Major acute care research is conducted within critical care research networks  
3 (CCRN). Our aims were to describe CCRN and participating ICUs.

4 **Methods:** A cross-sectional survey was conducted among all CCRNs belonging to the  
5 International Forum of Acute Care Trialists. A network questionnaire was sent to CCRN  
6 directors and an ICU e-questionnaire was sent to participating ICUS.

7 **Results:** Survey was answered by 366 ICUs from 17 CCRNs (median response rate 21% [12-  
8 38]). CCRNs have different organizations (ownership, memberships, funding). The number of  
9 studies conducted, patients included and publications varied a lot across CCRNs. The  
10 collaboration with other research networks or health authorities was very frequent (n=13,  
11 76%). Most ICUs (n=315; 86%) are located in large teaching hospitals in high income  
12 countries with a mean volume of 968 (842–1102 (95% CI)) annual admissions. The  
13 recognition at the academic level (n=133; 70%), the collaboration with experts (n=284; 85%),  
14 and improving practices (n=286; 86%) are incentives reported to belong to a CCRN.

15 **Conclusions:** Despite different organizations, CCRN share similar ventures including the  
16 value of improving quality of critical care delivery. Participating ICUs share several structural  
17 and managerial patterns. These observations enlighten the importance of CCRN to enhance  
18 quality of critical care delivery.

19

20 **Keywords:** critical care; health services research; organizations

21

22

23 **List of abbreviations**

24 ICU: intensive care unit

25 CCRN: critical care research network

26 PPY: person per year

27 GLM: generalized linear model

28

29 **Availability of data and material**

30 The datasets generated and analyzed during the current study are available from the  
31 corresponding author on reasonable request.

32 **Authors' contributions**

33 The study concept was created by YLN, GH and BG. YLN and GH had full access to all the  
34 data and took the responsibility of the integrity of the data and the accuracy of data analysis.  
35 Statistical analyses were carried out by GH and YLN. The manuscript was written by YLN  
36 and GH and revised by BG. Final approval of the version to be submitted was given by all  
37 coauthors. All authors read and approved the final manuscript.

38

39

40

**41 Background**

42 Thirty years ago, critical care research was dominated by industry supported or  
43 individual researcher led studies. Following the oncology or cardiology research networks  
44 models, the Canadian Critical Care Trial Group (CCCTG), created in 1989, has gathered  
45 academic researchers physically separated, whose aim was to implement collegially a  
46 research agenda driven by the interests and needs of clinicians. The originality of CCCTG  
47 was to follow a programmatic model of clinical research that includes both integrated series  
48 of investigations to determine best practices, the development of guidelines, translational  
49 research strategies and new research questions (1). The successes of CCCTG in terms of  
50 funding, studies completion and publications may have prompted the creation of other critical  
51 care research networks (2)(3).

52 The main advantages of conducting a trial within a research network are to benefit  
53 from a professional development opportunity, a mentorship by experienced researchers, to  
54 enhance funding opportunities and to speed up recruitment. Nowadays, most of the large  
55 observational or experimental acute care studies are conducted through critical care research  
56 networks (CCRN). The results of these studies contribute widely to the construction and  
57 update of international critical care guidelines or recommendations. But could we apply these  
58 results to all acute care settings? There is a unanimous agreement that current guidelines may  
59 not apply to hard-to-reach acute care settings in low and middle income countries. Then, a  
60 better knowledge of structural patterns of CCRN participating ICUs may help researchers,  
61 policy makers and funders, to better define future research studies at the era of global health.

62 The purposes of the present study were to describe CCRN and the structural and  
63 managerial patterns of participating ICUs and their research activities. Our study gives both  
64 insights into internal organizations of current CCRN and a detailed description of structural  
65 and managerial patterns of participating ICUs and their research activities.

66

67 **Methods**

68 The study protocol was approved by the Review board of the French Society of Critical Care  
69 Medicine in March 2013. This study was endorsed by the International Forum of Acute Care  
70 Trialists (InFACT) and by the European CCRN of the European Society of Intensive Care  
71 Medicine. A scientific advisory board gathered international experts on the field and the study  
72 was supported by the Health Services and Research Outcome section of the European Society  
73 of Intensive Care Medicine. Some of the results of this study have been previously reported in  
74 the form of abstracts.

75 *Study's design*

76 We conducted a cross-sectional survey. Directors of research networks were contacted  
77 through emails or directly during international meetings about critical care medicine. We used  
78 a broad definition of network including groups of ICUs mainly associated for composing a  
79 data registry.

80 *The network and the ICU questionnaires*

81 A network questionnaire and an ICU questionnaire were created for the study. The first  
82 versions of these questionnaires were written by YLN and BG, and were reviewed by the  
83 scientific advisory board of the study (composed of critical care experts on critical care  
84 organization and management). Composed of 22 open questions, the network questionnaire  
85 was sent to critical care network directors by email. The network questionnaire investigated  
86 network creation date, existence of a document stating the objectives and organization of the  
87 network, ownership, funding, partnerships, memberships (total number, pre-requisites,  
88 incentives, advantages), research activities (registry, studies settings, number of studies  
89 conducted, number of patients recruited, collection of biological samples, collaboration with  
90 other networks/public health authorities and number of publications).

91 Composed of 41 questions, the ICU questionnaire was created and administered using  
92 SurveyMonkey platform (SurveyMonkey Inc., Palo Alto, CA) under the form an e-  
93 questionnaire to be self-completed by responders via the Internet. An email with a link to the  
94 e-questionnaire was sent to each member of the participating networks by the network  
95 referent between May and December 2013. Questions were on hospital organization (teaching  
96 status, ownership, size, number of ICUs, facilities available in the ICU, presence of an  
97 intermediate care unit/medical emergency team); ICU organization (case-mix, physician  
98 staffing model, medical night-staffing, medical working hours); ICU admissions (beds  
99 number, annual admissions number (total, those with invasive mechanical ventilation, with  
100 renal support therapy); ICU resources (computerized physician order entry, electronic medical  
101 record system, medical error-reporting system, telemedicine); nurses (nurse to patients ratio,  
102 working patterns); allied health professionals (physician-assistants, respiratory therapists,  
103 nurse practitioners, nurse assistants, physiotherapists, pharmacists, dieticians, social workers,  
104 microbiologists); communication (daily multidisciplinary ICU round); quality improvement  
105 measures (nosocomial infections, written clinical protocols, patient-family satisfaction  
106 evaluation, quality improvement projects, benchmarking); and individual critical care network  
107 involvement (motivations for being part of the network, participation to studies, projects  
108 submitted to the research network, percentage of patients enrolled in studies, barriers to  
109 enrolling a patient in a study of the research network, resources provided by the network).

#### 110 *Participants*

111 The critical care research network directors submitted the study protocol to their scientific  
112 board of the network prior to participation in the study.

113 Phrasing of the questions was discussed and revised several times by the scientific advisory  
114 board. The e-questionnaire was translated in Spanish and Italian. We used special functions  
115 for avoiding missing data (e.g. mandatory answers in order to get to next question). In order

116 to enhance response rate, three reminders were sent to critical care research members during  
117 the study period, and several emails with the participation rate to the e-survey were sent to  
118 research network directors. We planned to directly contact the directors of the participating  
119 ICUs through email, in the case of missing data. Sample size was not an issue in this study  
120 aiming first at the description of CCRNs' organizations.

### 121 *Statistical methods*

122 We conducted descriptive analyses for documenting ICU characteristics across CCRNs.  
123 Questionnaires with more than 50% missing answers or duplicate completions were excluded  
124 from the analysis. Qualitative variables are presented as percentages, while quantitative  
125 variables are shown either as means together with the corresponding 95% confidence interval,  
126 or as medians together with the interquartile range (IQR). The exploration of the association  
127 between ICU volume and structural patterns was limited to patterns previously reported for  
128 being associated with improved outcomes (teaching status, closed ICU model, 24/7 intensivist  
129 coverage, daily multi-disciplinary round, cumulative presence of written procedures, presence  
130 of an intermediate care unit, presence of a medical emergency team). Volume admission  
131 handled as an ordinal variable characterizing the number of admissions per year was  
132 investigated for its association with structural patterns using a generalized linear model  
133 (GLM). In a second step, a multivariable GLM analysis was performed for all variables with  
134 a p value  $\leq 0.20$  in the bivariate analyses. Because we anticipated that potential missing data  
135 would be difficult to appropriately handle with imputation techniques (suspecting that the  
136 rationale for missing data in this survey would not be any kind of random-like process), we a  
137 priori decided to remove any record with missing data encountered in a given analysis. All  
138 analyses were performed with R statistical freeware version 3.5.0.

### 139 **Results**



140 We sent 21 invitations to participate to our study in October 2011 and 19 CCRNs (AMIBNet  
141 (Associação de Medicina Intensiva Brasileira Network), ANZICS (Australian and New  
142 Zealand Intensive Care Society Trials group), ARDSNet (Acute Respiratory Distress  
143 Syndrom Network), ASDI (Austrian Network), AZURéa (French Network focused on peri-  
144 operative care), CCCTG (Canadian Critical Care Trial Group), CCCTG (Chinese Critical  
145 Care Trial Group), BRICNet (Brazilian network), CUB-Réa (French Network), ECCRN  
146 (European Critical Care Research Network), EDUSepsis (Spanish Network focused on  
147 Sepsis), GiVITI (Italian Network), NICE (Dutch Network), OUTCOMERéa (French  
148 Network), PROSAFE (Polish, Hungarian, Slovenian, Greek and Cyprian Network), RéVA  
149 (European network focused on mechanical ventilation), SCCTG (Scandinavian Critical Care  
150 Trial Group), SEPNET (German Network focused on sepsis), USCIITG (United States  
151 Critical Illness and Injury Trial group) ) accepted to participate (the 2 that could not  
152 participate were from France and from the United Kingdom). The two questionnaires were  
153 sent in May 2013. Data was collected between May and December 2013.

154 Considering the initial 399 ICUs questionnaires finally documented, 33 (8%) were excluded  
155 because of too poor a completion content (n=5) or duplicate completion (n=28), finally  
156 resulting in 366 responses analyzed. National CCRN were considered the main network of  
157 belonging so we did not evaluate EECRN individually. The 2 ICUs belonging to AZURéa  
158 also belonged to another larger national network so we did not evaluate AZURéa separately.

#### 159 *Networks characteristics (Tables 1 and 2)*

160 The median [IQR] participation rate of the networks was 21% [12%–38%]. Responder ICUs  
161 originated from 15 countries with Europe predominantly represented (n=228, 62%); the five  
162 most frequent countries being the Netherlands (n=57, 16%), Spain (n=49, 13%), Brazil (n=44,  
163 12%), Italy (n=44, 12%), and France (n=30, 8%). Membership belonging to networks  
164 concerned either ICUs (n=10; 59%), either individuals (n=5; 29%) or both (n=2; 12%).

165 Network funding was often mixed (association of public, private funding and membership  
166 fees), and ranged from 0.1 to hundreds of millions of dollars. The number of studies  
167 conducted, patients included and publications varied a lot across CCRNs. Some CCRNs (n=4,  
168 24%) conducted studies involving emergency departments, operating rooms, post-anesthesia  
169 care unit and ambulances services. Many CCRNs had a registry data (n=12, 70%), and 5  
170 (28%) collect biological samples. The collaboration with other research networks or health  
171 authorities was very frequent (n=13, 76%).

172

### 173 *ICU participation to CCRN (Table 3)*

174 Most ICU directors agreed or strongly agreed that belonging to a CCRN is an important  
175 feature contributing to being recognized at the academic/social level (n=233; 70%), to  
176 collaborate with experts in the field (n=284; 85%), to improve practices (n=286; 86%) leads  
177 to changes in their local practices (n=243; 73%). Majority agreed or strongly agreed that  
178 contributing in a CCRN is time consuming (n=243; 73%) and had hired a research assistant or  
179 data manager (n=172; 52%). During the last 3 years, ICUs participated in 2 [1-3]  
180 observational and 1 [0-2] randomized controlled studies. Majority of ICUs did not submit any  
181 research proposal (n=179; 54%). Most ICU directors (n=229; 75%) recognize having enrolled  
182 less than 10% of their patients in CCRN studies. The major barriers to enrolling a patient  
183 were the lack of manpower (n=156; 47%), the consent not obtained (n=147; 44%), a protocol  
184 too complex or time consuming (n=142; 43%) and the non-adhesion of other clinicians (n=11;  
185 33%). Regarding network support, most common resources provided were statistical (n=159;  
186 44%) or logistical support (n=146; 45%) and money (n=67; 20%).

187

### 188 *Hospital organization (Additional file 1)*

189 Most ICUs were located in teaching hospitals (n=293; 80%). The median number of staffed  
190 ICU beds was 15 [9-22] and the annual volume of admissions was 968 [842–1102]. Majority  
191 of ICUs worked with an intermediate care unit (n=196; 54%) and with an in-hospital medical  
192 emergency team (n=261; 71%). An increasing ICU annual volume of admissions was  
193 associated with teaching status ( $p=8 \times 10^{-14}$ ) and the presence of a medical emergency team  
194 ( $p=7 \times 10^{-3}$ ).

195

196 *ICU organization and resources (Additional file 2)*

197 Most ICUs had an adult mixed patient case-mix (n=275; 74%), a closed model (n=322; 88%),  
198 a 24/7 intensivist coverage (n=254; 69%) and a daily multi-disciplinary round (n=268; 76%)  
199 High-volume ICUs were more likely to have a closed model ( $p=0.03$ ) and established written  
200 protocols ( $p<0.01$ ). The majority of ICUs had more nurses than a regular ward (n=344; 94%),  
201 and single patients rooms (n=237; 65%). Approximately two-thirds of ICUs had a  
202 computerized physician order entry (n=221; 61%), an electronic medical record system  
203 (n=236; 66%) and a medical error reporting system (n=234; 65%).

204

205 *Working patterns of physicians, nurses and allied health care workers (Additional file 3)*

206 The majority of the respondents declared that junior physicians work less than 50 h per week  
207 (n=190; 52%) and that senior physicians work between 51 and 70 h per week (n=192; 53%).  
208 The occurrence of extended night shifts (>16h) was common (n=218; 60%).  
209 The most frequent working patterns of nurses were 3 x 8 h (n=173; 48%). The presence of a  
210 physician assistant (n=179; 51%), a nurse-practitioner (n=221; 62%), a nurse-assistant  
211 (n=244; 69%), a physiotherapist (n=288; 81%), a pharmacist (n=197; 56%) and a dietician  
212 (n=205; 58%) was frequent. Less than half of ICUs had access to a social worker (n=167;  
213 47%) or a microbiologist (n=138; 39%).

214

215 *Quality improvement measures (Additional file 4)*

216 The majority of ICUs declared measuring their rate of nosocomial infections (n=331; 94%),  
217 implementing quality improvement measures to reduce them (n=306; 87%) and conducting  
218 routine benchmarking with other ICUs (n=283; 80%). Most ICUs declared having established  
219 protocols for weaning from mechanical ventilation (n=224; 64%), sedation management  
220 (n=266; 76%), protective ventilation for acute lung injury (n=228; 65%), early goal therapy  
221 for sepsis (n=226; 64%) and glucose management (n=305; 87%). High-volume ICUs were  
222 more likely to have established written protocols (p<0.01).

223

224

225 **Discussion**

226 To our knowledge, this study is the first describing major CCRN and structural patterns of  
227 participating ICUs. We found that CCRNs have different organizational patterns and  
228 resources, do not limit strictly their research to the ICU setting and collaborate frequently  
229 with each other.

230 Most ICUs are located in large teaching hospitals and share similar structural and managerial  
231 patterns. Regarding their participation to CCRN, the benefits reported are the recognition at  
232 the academic level, working with experts and enhancing their own clinical practice. The  
233 average rate of patients included in CCRN studies remained low.

234

235 *Critical care research networks are organized differently but share similar vision*

236 The differences between CCRNs may be partly related to their age, to different critical care  
237 delivery organizations and the lack of professional society's recommendations. It is not  
238 surprising that the oldest CCRNs (CCCTG, ARDSNet and ANZICS) had higher levels of  
239 funding and a higher number of conducted studies or publications. The different types of

240 memberships (individuals versus ICUs) observed in our study might be related to the different  
241 roles of ICU directors (mainly administrative or managerial) across health care systems. The  
242 frequent collaboration observed between CCRNs and between CCRNs and health authorities,  
243 is partly related to belonging to the InFACT group that promotes this vision of promoting  
244 international collaboration (4).

245

#### 246 *Participating ICUs share the same motivations and difficulties*

247 The underlying motivations of belonging to a CCRN appear laudable and our results  
248 enlighten us in the potentially positive impact of being part of a CCRN in terms of the quality  
249 of care delivered. In the lack of quality improvement through regional outreach, as a way to  
250 improve quality of care, health care authorities might encourage ICUs to be part of a CCRN  
251 (5). But, given the lack of international evaluation of CCRN (unlike HIV/AIDS research), the  
252 use of CCRN participation as a surrogate of quality of care, appears to be too premature (6).

253 As previously mentioned, the rate of patient's enrollment remained low within ICUs(1). The  
254 barriers reported are related to the lack of time and difficulties regarding the consent process.  
255 As suggested by Cook et al., potential strategies to increase patient's enrollment efficiency are  
256 more participating center, weekends or afterhours enrolment or co-enrolment with another  
257 trial (7). Co-enrolment seems appealing particularly in a variety of paired study designs (e.g.  
258 experimental and observational) but may lead to a plausible co-enrolment effect (7). To  
259 facilitate the reporting of co-enrolment, recent guidelines suggest the use of the SPICE-8  
260 criteria (8).

261

#### 262 *Participating ICUs to CCRN share similar structural and managerial patterns*

263 Despite the absence of a consensual definition of critical care and a wide variation of critical  
264 care delivery across health care systems, participating ICUs share several organizational and

265 managerial patterns, some of them being associated with improved outcomes  
266 (9)(10)(11)(12)(13)(14)(15). Whether sharing similar structural patterns are related to the  
267 participation to a CCRN or to national recommendations remains unknown. These results  
268 highlight that current published evidence is mainly based on data of patients hospitalized in  
269 ICUs located in large teaching hospitals with a lot of manpower. An evaluation of the benefits  
270 of current recommendations in ICUs located in small community hospitals or with less  
271 manpower, might seem justified. Such evaluation is already conducted in ICUs located in  
272 hard-to-reach settings in low and middle income countries, that have sicker patients and lower  
273 resources(16)(17).

274

#### 275 *Study limitations*

276 Our study has several limitations. As any survey, our study may suffer from a selection bias.  
277 Nevertheless and interestingly, the median participation rate of the networks observed in this  
278 study was not significantly different ( $p=0.46$ ) from that issued from the participation rates to  
279 online surveys reported in a meta-analysis exploring such rates (18). Despite having excluded  
280 all ICUs with repeated or missing data and having contacted ICU directors directly, some data  
281 might be misleading or not reflect clinical practice at bedside (e.g. compliance to written  
282 protocols). Our data is 6 years old and it is possible that some ICUs' features may have  
283 changed. Indeed, in the era of global health, the InFACT group has broadened its  
284 collaborations since 2013 and is currently developing programs for pandemic preparedness,  
285 education, mentorship and research in geographic areas that were previously underrepresented  
286 (19)(20).

287

#### 288 *Conclusions*

289 This study indicates that despite having different organizational patterns, CCRN share similar  
290 ventures, especially the value of improving quality of critical care delivery which appears to  
291 be one of the main motivations of the participating centers. CCRN participating ICUs share  
292 several structural and managerial patterns which have been reported as being associated with  
293 improved clinical outcomes. These observations enlighten the importance of CCRN to  
294 enhance quality of critical care delivery and the benefits of conducting interventional trials  
295 within CCRN.

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321  
322 Critical care research group websites:  
323  
324 AMIBNet <http://www.amib.org.br/>  
325 ANZICS <https://www.anzics.com.au/>  
326 ASDI <https://www.asdi.ac.at>  
327 AZURéa <https://www.azurea.org>  
328  
329 CCCTG <https://www.ccctg.ca/>  
330  
331 CCCCTG <http://cscdm.org/cn/>  
332 BricNet <http://www.bricnet.org/>  
333 CUBRéa  
334 ECCRN <https://www.esicm.org>  
335 EDUsepsis <https://www.edusepsis.org>  
336 GiVITI <https://www.giviti.marionegri.it/>  
337  
338 INFACt <https://www.infactglobal.org/>  
339 NICE <https://www.stichting-nice.nl/>  
340  
341 OUTCOMERéa <http://outcomerea.fr/>  
342 PROSAFE <http://prosafe.marionegri.it>  
343 RéVA [www.reseau-reva.org/](http://www.reseau-reva.org/)  
344 SCCTG [www.ssai.info/research/scandinavian-critical-care-trials-group/](http://www.ssai.info/research/scandinavian-critical-care-trials-group/)  
345 SEPNET [www.sepsis-gesellschaft.de/DSG/Deutsch/Forschung/SepNet](http://www.sepsis-gesellschaft.de/DSG/Deutsch/Forschung/SepNet)  
346  
347 USCIITG [www.usciitg.org/](http://www.usciitg.org/)  
348  
349  
350

351 **References**

- 352
- 353 1. Marshall JC, Cook DJ, Canadian Critical Care Trials Group. Investigator-led clinical  
354 research consortia: the Canadian Critical Care Trials Group. *Crit Care Med.* 2009  
355 Jan;37(1 Suppl):S165–72.
- 356 2. Cook D, Brower R, Cooper J, Brochard L, Vincent J-L. Multicenter clinical research in  
357 adult critical care. *Crit Care Med.* 2002 Jul;30(7):1636–43.
- 358 3. Jones DA, Cooper DJ, Finfer SR, Bellomo R, Myburgh JA, Higgins A, et al. Advancing  
359 intensive care research in Australia and New Zealand: development of the binational  
360 ANZIC Research Centre. *Crit Care Resusc J Australas Acad Crit Care Med.* 2007  
361 Jun;9(2):198–204.
- 362 4. InFACT [Internet]. Available from: <https://www.infactglobal.org/our-vision>
- 363 5. Nguyen Y-L, Kahn JM, Angus DC. Reorganizing adult critical care delivery: the role of  
364 regionalization, telemedicine, and community outreach. *Am J Respir Crit Care Med.*  
365 2010 Jun 1;181(11):1164–9.
- 366 6. Kagan JM, Kane M, Quinlan KM, Rosas S, Trochim WMK. Developing a conceptual  
367 framework for an evaluation system for the NIAID HIV/AIDS clinical trials networks.  
368 *Health Res Policy Syst.* 2009 May 21;7:12.
- 369 7. Cook DJ, Blythe D, Rischbieth A, Hebert PC, Zytaruk N, Menon K, et al. Enrollment of  
370 intensive care unit patients into clinical studies: a trinational survey of researchers’  
371 experiences, beliefs, and practices. *Crit Care Med.* 2008 Jul;36(7):2100–5.
- 372 8. Reade MC, Bass F, Howe B, Seppelt I, Shehabi Y. Considerations for co-enrolment in  
373 randomised controlled effectiveness trials in critical care: the SPICE-8 co-enrolment  
374 guidelines. *Crit Care Resusc J Australas Acad Crit Care Med.* 2017 Jun;19(2):110–4.
- 375 9. Arabi YM, Phua J, Koh Y, Du B, Faruq MO, Nishimura M, et al. Structure,  
376 Organization, and Delivery of Critical Care in Asian ICUs. *Crit Care Med.* 2016  
377 Oct;44(10):e940–8.
- 378 10. Sakr Y, Moreira CL, Rhodes A, Ferguson ND, Kleinpell R, Pickkers P, et al. The impact  
379 of hospital and ICU organizational factors on outcome in critically ill patients: results  
380 from the Extended Prevalence of Infection in Intensive Care study. *Crit Care Med.* 2015  
381 Mar;43(3):519–26.
- 382 11. Estenssoro E, Alegría L, Murias G, Friedman G, Castro R, Nin Vaeza N, et al.  
383 Organizational Issues, Structure, and Processes of Care in 257 ICUs in Latin America: A  
384 Study From the Latin America Intensive Care Network. *Crit Care Med.* 2017  
385 Aug;45(8):1325–36.
- 386 12. Capuzzo M, Volta C, Tassinati T, Moreno R, Valentin A, Guidet B, et al. Hospital  
387 mortality of adults admitted to Intensive Care Units in hospitals with and without  
388 Intermediate Care Units: a multicentre European cohort study. *Crit Care Lond Engl.*  
389 2014 Oct 9;18(5):551.

- 390 13. Maharaj R, Raffaele I, Wendon J. Rapid response systems: a systematic review and  
391 meta-analysis. *Crit Care Lond Engl*. 2015 Jun 12;19:254.
- 392 14. Wilcox ME, Chong CAKY, Niven DJ, Rubenfeld GD, Rowan KM, Wunsch H, et al. Do  
393 intensivist staffing patterns influence hospital mortality following ICU admission? A  
394 systematic review and meta-analyses. *Crit Care Med*. 2013 Oct;41(10):2253–74.
- 395 15. Wallace DJ, Angus DC, Barnato AE, Kramer AA, Kahn JM. Nighttime intensivist  
396 staffing and mortality among critically ill patients. *N Engl J Med*. 2012 May  
397 31;366(22):2093–101.
- 398 16. Vukoja M, Riviello ED, Schultz MJ. Critical care outcomes in resource-limited settings.  
399 *Curr Opin Crit Care*. 2018 Oct;24(5):421–7.
- 400 17. Diaz JV, Riviello ED, Papali A, Adhikari NKJ, Ferreira JC. Global Critical Care:  
401 Moving Forward in Resource-Limited Settings. *Ann Glob Health*. 2019 Jan 22;85(1).
- 402 18. Shih Tse-Hua, Fan Xitao. Comparing Response Rates from Web and Mail Surveys: A  
403 Meta-Analysis. *Field Methods* 2008 [Internet]. 2008 Apr 29;20(249). Available from:  
404 <http://fm.sagepub.com/cgi/content/abstract/20/3/249>
- 405 19. InFACT Global H1N1 Collaboration. InFACT: a global critical care research response  
406 to H1N1. *Lancet Lond Engl*. 2010 Jan 2;375(9708):11–3.
- 407 20. Simonsen L, Higgs E, Taylor RJ. Clinical research networks are key to accurate and  
408 timely assessment of pandemic clinical severity. *Lancet Glob Health*. 2018;6(9):e956–7.
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411 List of tables :

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