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HAND HYGIENE COMPLIANCE IN THE INTENSIVE CARE UNIT: A SYSTEMATIC REVIEW

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ABSTRACT

Objectives: To synthesize the literature describing compliance with WHO hand hygiene (HH) guidelines in Intensive Care Units (ICUs), to evaluate the quality of extant research, and to examine differences in compliance rates across geographical regions, ICU types, and healthcare worker groups, observation methods, and Moments (indications) of HH.

Data sources: Electronic searches were conducted in August 2018 using Medline, CINAHL, PsycInfo, Embase, and Web of Science. Reference lists of included studies and related review articles were also screened.

Study selection: English-language, peer-reviewed studies measuring HH compliance by healthcare workers in an ICU setting using direct observation guided by the WHO's 'Five Moments of Hand Hygiene', published since 2009, were included.

Data extraction: Information was extracted on study location, research design, type of ICU, healthcare workers, measurement procedures, and compliance rates.

Data synthesis: Sixty-one studies were included. Most were conducted in high-income countries (60.7%) and in adult ICUs (85.2%). Mean HH compliance was 59.6%. Compliance rates appeared to differ by geographic region (high-income countries 64.5%, low-income countries 9.1%), type of ICU (neonatal 67.0%, pediatric 41.2%, adult 58.2%), and type of healthcare worker (nursing staff 43.4%, physicians 32.6%, other staff 53.8%).

Conclusions: Mean HH compliance appears notably lower than international targets. The data collated may offer useful benchmarks for those evaluating, and seeking to improve, hand hygiene compliance in ICUs internationally.

Key words: critical care; hand disinfection; hand hygiene; intensive care; systematic review

INTRODUCTION

Healthcare-associated infections (HAIs) affect 4% of patients worldwide and account for almost 100,000 deaths annually in the USA(1, 2). Improvement in hand hygiene (HH) practices has been highlighted as the most effective safeguard against HAIs(3), and the World Health Organization's (WHO) Five Moments of Hand Hygiene have been widely adopted(4, 5). However, poor HH compliance remains a concern and research priority internationally(6).

HH is of particular concern in the Intensive Care Unit (ICU), where immunocompromised patients are particularly vulnerable to infection. HAI prevalence rates of between 20% and 30% have been reported in ICU settings(7). A variety of interventions have been trialed to improve HH in ICU settings(6); however, the level of baseline HH compliance in ICUs internationally is unknown. This is important information for local assessors of HH compliance at hospital and national level, in order to contextualize local compliance and determine appropriate benchmarks and targets.

A review of the literature (prior to 2009) on HH compliance rates found median compliance rates of 40-50% in ICUs and 50-60% in non-ICU settings(8). However, the reviewed studies predate the WHO guidelines and do not reflect current practice and conditions.

Therefore, the primary aim of this systematic review was to identify studies that have measured HH compliance rates in ICU settings in accordance with the WHO guidelines, and to derive an estimate of HH compliance from these studies. The secondary aim of the review was to investigate whether HH compliance rates differ by region, ICU type, healthcare worker group, method of observation (i.e., covert, not covert), and individual moment (indication) of HH.

METHOD

This review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Guidelines(9). The review protocol was registered with PROSPERO (ref. CRD42018095336).

Study identification

Five databases were searched in August 2018: Medline, CINAHL, PsycInfo, Embase, and Web of Science. The search strategy included MEdical Subject Headings (MESH) search terms and keywords. Search terms were selected for three domains: hand hygiene (e.g., "hand cleansing"), hospital settings (e.g., "critical care"), and compliance (e.g., "rates"). The Medline search strategy is shown in the Supplemental Digital Content 1. This search was modified as necessary for other databases. These electronic searches were also supplemented by screening the reference lists of all studies identified for inclusion and those of 11 related review articles (10-19).

Study selection

Inclusion criteria required that a study: 1) be published in a peer-reviewed journal, in English, and after 2009; 2) reported HH compliance among HCWs in an ICU, either in the absence of any intervention or before the implementation of an intervention (i.e., at baseline); and 3) measured HH compliance by means of direct observation of at least one of the five WHO HH Moments.

Studies were excluded for a number of reasons. First, studies that examined compliance in both ICUs and other areas of the hospital were only considered for inclusion where data on compliance in ICUs could be extracted. Next, studies that examined compliance among both HCWs and other populations (e.g., patients, visitors) were only considered for inclusion where data on compliance among HCWs could be extracted. Further, studies using self-report measures, proxy measures (e.g., hand rub consumption), or observation using other indicators for HH (e.g., entry-exit, indicators from the Centre for Disease Control (CDC) guidelines) were excluded. Finally, data were extracted only where it was possible to determine the corresponding total number of observed HH opportunities. Therefore, studies that reported percentage compliance only were not included.

Titles and abstracts of articles returned during the search were screened using the inclusion criteria. The full texts of articles appearing to meet the inclusion criteria, or for which information in the title and abstract was insufficient to determine whether the study met inclusion criteria, were obtained for review. Ambiguities regarding inclusion or exclusion of these studies were resolved through discussion between authors until consensus was achieved.

Data extraction

Two authors extracted data independently and resolved any discrepancies through discussion. Information was extracted on the following variables using a structured form: location (country; region and income group per World Bank classification (20), research design (intervention, observational), ICU type, participant group, sample size, observation method (covert, not covert; i.e., whether HCWs were aware of the observation), assessment of inter-rater reliability, training of observers, Moments observed (Moment 1, before patient

contact; Moment 2, before aseptic procedures; Moment 3, after body fluid exposure/risk; Moment 4, after patient contact; Moment 5, after contact with patient's surroundings), number of opportunities observed for each Moment and for all observed Moments pooled, and percentage compliance for each Moment and for all observed Moments pooled.

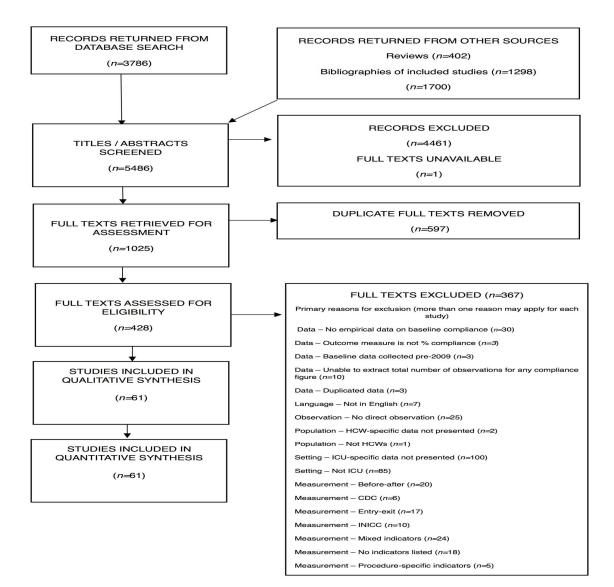
Quality assessment

Risk of bias was assessed by two authors, using the Quality Assessment Tool for Studies of Diverse Designs (QATSDD) (21). Disagreements were resolved through discussion until consensus was achieved. The tool comprises 16 indicators assessing the quality of reporting and the appropriateness of data collection methods and analysis. Each indicator is scored on a 4-point scale, with higher scores indicative of better methodological quality. Two items relating only to qualitative studies were removed. Total scores could therefore range from 0 to 42. The tool has been shown to be reliable and valid(21) and has been used in other reviews relating to health services research and patient safety(22-25).

RESULTS

More than 5,480 articles were screened, of which 61 studies met the inclusion criteria (Figure 1). Table 1 presents a summary of the included studies (for more detail, see Supplemental Digital Content 2).

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram.



Study location*	Europe & Central Asia	Middle East & North Africa	East Asia & Pacific	Latin An & Caribb		North America	South As	ia Sub-Saharan Africa		
No. studies (%)	22 (36.1%)	11 (18.0%)	11 (18.0%)	7 (11.5%)	5 (8.2%)	5 (8.2%)	3 (4.9%)		
Study location income*	High income	Upper m income	iddle	Lower midd	le incom	e Low in	icome	Missing (continent only specified)		
No. studies (%)	38 (62.3%)	12 (19.7	%)	9 (14.8%)		3 (4.9%	6)	1 (1.6%)		
Participants	All HCWs or r HCW groups	nultiple Doctor nurses		Nurses only	7	Nursin	g staff only	Unspecified HCW group		
No. studies (%)	25 (41.0%)	10 (16	.4%)	4 (6.6%)		2 (3.3%	6)	20 (32.8%)		
ICU Type (Adult)	All Adult	Medical IC	U Surgical	ICU	Medical- surgical IC	Cardiac- CU related IC	CU Other ICU**			
No. studies (%)	52 (85.2%)	30 (49.2%)	7 (11.5%)	10 (16.49	6)	6 (9.8%)	4 (6.6%)	10 (16.4%)		
ICU Type (Non-adult)	All Pediatric	Pediatric ICU	J Pediat ICU	tric surgical	All Nec	onatal	Neonatal ICU	Neonatal surgical ICU		
No. studies (%)	10 (16.4%)	10 (16.4%)	1 (1.6	%)	12 (19.	7%)	12 (19.7%)	1 (1.6%)		
Study design	Intervention			Observation method		Covert	Not cover	rt Not reported		
No. studies (%)	25 (41.0%)	36 (59	.0%)	No. studi	es (%)	12 (19.7%)) 36 (59.0%	⁽⁶⁾ 16 (26.2%)		
WHO Moments Observed	Moments All Moments		ts 4 and 5	ents 1, 4,	Momen (before contact)		Moment 2 only (before aseptic task)	vioments Land		
No. studies (%)	52 (85.2%)	3 (4.9%)	2 (3.3	%)	2 (3.3%	6)	1 (1.6%)	1 (1.6%)		

Table 1. Characteristics of 61 included studies assessing HH compliance in ICU

No. studies (%)52 (85.2%)3 (4.9%)2 (3.3%)2 (3.3%)1 (1.6%)1 (1.6%)*Note: Figures do not total to 61 because some studies fit within more than one of the categories (e.g., were conducted in both adult and pediatric settings).

***Note:* Cardiac-related: Coronary / cardiac care ICU; Cardiovascular and thoracic ICU; Cardio-surgical ICU. Other: Gastroenterology ICU; Liver ICU; Neurosurgery ICU; Neurologic ICU; Respiratory care ICU; Trauma ICU; Intensive therapy unit; Anesthesiological-surgical ICU; Burn unit; Kidney center; Internal ICU; Critical care unit; Anesthesiological and reanimation ICU.

Location

Studies were most frequently conducted in Europe and Central Asia, followed by the Middle East and North Africa (see Table 1). The majority of studies were conducted in highincome countries.

Settings and participants

A majority of studies took place in adult ICU settings. A total of 80% of studies did not report sample size. Across the remaining studies, the mean number of participants was 149 (SD=202.0). Over 70% of studies included multiple HCW groups or all ICU HCWs (see Table 1).

Design and observation method

The majority of included studies were observational. Observation of HH compliance was generally not covert. More than 90% of studies measured all five WHO Moments (see Table 1).

Compliance rates

Table 2 presents rates of HH compliance in ICU, stratified by study location income classification, ICU type, HCW group, study design, and observation method. The median number of opportunities observed per study was 903 (mean = 3,026). Overall compliance rates ranged from 1.4% to 100% and weighted mean compliance rate was 59.6% (n=184,597 opportunities). Thirteen studies provided data on compliance for individual Moments. Of

these, compliance was most frequently reported for Moment 1 and was highest for Moment 4 (see Table 2)

As can be seen in Table 2, there were notable differences in compliance between high- and low-income countries. Further, compliance was highest for non-nursing and nonphysician HCWs and highest in neonatal ICU settings. Compliance appeared similar when measured using covert and non-covert means.

Variables	No. studies	No. opportunities	Weighted mean % compliance	Weighted SD	Range
WHO Moments					
All observed Moments Moment 1 (before patient	61	184597	59.6	15.88	1.4- 100.0 16.0-
contact) Moment 2 (before	14	6521	33.5	15.81	82.0
clean/aseptic task) Moment 3 (after fluid	13	2633	29.4	13.08	1.4-67.0
exposure/risk) Moment 4 (after patient	12	2447	42.5	19.13	8.4-82.0 29.2-
contact) Moment 5 (after contact with	11	4478	52.7	18.59	86.4
patient's surroundings)	9	4175	45.2	17.7	2.3-80.2
Observation method					23.8-
Covert	12	14378	57.9	14.63	23.8- 78.0 1.4-
Not covert	36	115266	58.3	17.2	100.0
Study location income					1.4
High income	37	124016	64.7	14.13	1.4- 100.0
Upper middle income	12	14062	43.0	18.01	6.7-70.7 11.7-
Lower middle income	8	11005	42.5	19.97	78.0
Low income	2	285	9.1	11.08	2.4-27.3
Participants					
Nurses and nursing staff	21	20786	43.4	13.64	1.4-74.6
Physicians	16	5760	32.6	10.84	0.0-56.0 35.4-
Other staff	5	1178	53.8	23.47	86.9
ICU type					
Adult	49	145912	58.2	16.04	1.4- 100.0 11.7-
Pediatric	6	2843	41.2	19.53	64.0 27.3-
Neonatal	10	5461	67.0	16.67	88.0

Table 2. Rates of compliance with HH

Note: Figures may differ from those presented in Table 1 because not all studies present data for each subgroup (e.g., a study may be conducted in multiple named ICU types but present only a pooled compliance rate).

Quality of included studies

The mean QATSDD score was 18.2 (*SD*=3.63). Studies generally performed well on items relating to the fit between the research question and methods of data collection and analysis, and the description of data collection procedures and research settings. Studies performed poorly on items relating to theoretical framework, consideration of sample size, and statistical assessment of the reliability and validity of measurement tools.

DISCUSSION

The primary aim of this review was to derive an estimate of mean HH compliance in ICU settings. Based on the 61 studies included, we estimated mean compliance to be 59.6%. The data collated also reveal that HH compliance rates appear to differ by region, ICU type, HCW group and individual Moment (indication) of HH.

Determining appropriate targets for minimum acceptable HH compliance is an important challenge. Mathematical models have been used to examine the potential impact of improved HH on infection rates. One model (26) indicated that relationship between HH compliance and prevalence of infection is asymptotic, not linear, and is subject to the law of diminishing returns: "The greatest benefits are derived from the first tranche of compliance, with higher levels (>50%) of hand hygiene yielding only marginal benefits"(26). While there is no universally agreed minimum acceptable level of compliance, a number of countries use 80% or 90% as a baseline target, including Australia, Canada, Ireland, and New Zealand(27-30), and the WHO recommends that HH role models have compliance of at least 80%(31). However, the evidence for why a minimum of 80% is desirable would appear to be lacking.

Given that the mean compliance rate in the papers included in this review is considerably less than 80%, it is suggested that there is a need to examine the rationale behind any HH compliance targets, and identify evidence-based interventions to improve HH compliance something that is also lacking(6). The findings presented here allow assessors of hand hygiene at hospital and national levels to compare local findings to meaningful reference groups (e.g., to other countries in the same income class).

Greater compliance rates were reported in studies from high-income countries, where the majority of the included studies were completed. The two included studies presenting data from low-income countries reported comparatively low compliance rates (2.4%(32) and 27.3%(33)). Poor hand hygiene resourcing and infrastructure in low-income countries was identified as a potential contributor to these low rates (32, 33). While further research focused on these lower-income countries is necessary, this initial synthesis suggests a need for research and initiatives focused on how best to improve HH in these regions, and within the resource constraints in healthcare systems in these countries.

Compliance was highest in neonatal ICU settings, and lowest in pediatric ICU settings. The reasons for the distinctly different compliance rates between pediatric and neonatal ICUs are unclear. It is possible that the infection risk is more salient for staff in neonatal ICUs; newborns in ICU are at increased risk due to underdeveloped immune systems, lack of vaccination, and the close quarters typical in neonatal ICUs(34, 35). However, these risk factors are arguably present for patients in pediatric ICUs. The findings highlight the importance of specific studies of HH practice in non-adult ICU settings and the engagement with staff surrounding barriers and facilitators to HH compliance that may be unique to their setting or context.

Across ICU staff, physicians had the lowest rate of compliance-reflecting the findings of previous research(8). "Other" staff members (non-physician and non-nursing staff) had the

highest rate of compliance. This is an important finding, as it will help those responsible for local and national interventions to more effectively target their efforts and resources. Interventions to specifically improve compliance among physicians may be of particular value, given their relatively poor performance and the lack of attention this group has received; a previous review of HH interventions(6) found only one study targeting physicians only(36).

Interestingly, similar rates of compliance were reported in studies using covert and noncovert methods of observation. This is surprising, considering the existing literature on the Hawthorne effect(37), whereby research participants behave differently when they know they are being observed; this effect has been observed in some HH studies. In light of this finding that similar results are obtained across the two methods, researchers and auditors may be encouraged to favor non-covert means of observation, which are less difficult and resourceintensive to implement.

Compliance was not uniform for all five WHO Moments; highest compliance was associated with Moment 4 and lowest compliance with Moment 2. Lower compliance rates were associated with Moments 1 and 2 than with Moments 3, 4 and 5. This may reflect a distinction between HH indications intended to protect the patient (i.e., Moments 1 and 2) and those to protect the HCW (i.e., Moments 3, 4, and 5), an issue that has been highlighted in a number of the included studies (39, 40). Previous research has suggested a superior knowledge or awareness of self-protective HH actions among HCWs, or stronger motivation to engage in these actions (41). In order to examine this issue, it is recommended that HH compliance studies evaluate and present data on compliance with each of the five Moments; this should also be a priority for hospital audits at local level.

Limitations

This review had a number of limitations. First, only articles published in peer-reviewed journals in English were considered; therefore, relevant studies in the grey literature or other languages may have been missed. Second, only studies that used the WHO Five Moments for Hand Hygiene were included. The WHO guidelines are the most widely used and influential guidelines on hand hygiene compliance (5). This inclusion criterion was applied to ensure comparability across studies, but led to the exclusion of studies of compliance in ICU that used other measures (see Figure 1).Third, we assessed the quality of studies using the QATSDD tool (21). The tool has been assessed by its authors for reliability and validity (21) and was used by two authors for each study in this review. However, the evaluation is subjective and concerns have been raised about the tool's structure, particularly around the equal weighting of all items for all studies (42). Fourth, the analysis presented here is descriptive only as this was considered most appropriate; we have described trends in the data but cannot comment on whether these are statistically significant. Figures should therefore be interpreted with caution, particularly in cases where relatively small numbers of observations were reported.

Future research

The quality of studies, as assessed using the QATSDD tool, was mixed. Studies performed well on items relating to the fit between the research question and methods of data collection and analysis; however, this is to be expected, as these studies were specifically selected for their use of the WHO guidelines for direct observation of hand hygiene, regarded as the 'gold standard' method for data collection (15).

Most of the studies presented in this review (77%) failed to establish the reliability and validity of data collection processes and most (70%) did not clarify training procedures for auditors. This is an important issue for future studies to address; in the absence of reliable and valid data, we cannot know the levels of HH compliance, determine the effectiveness of interventions, or make comparisons between settings, HCW groups or regions (43). Relatedly, more detailed data collection and reporting (i.e., compliance rates stratified by HCW group, individual Moment, etc.) in future studies will allow researchers and policymakers to identify particular HCW groups, and particular hand hygiene behaviors, for which targeted intervention is required. Our review has identified compliance rates in the published literature, and collated compliance rates for each of the five Moments of HH. Our data does not examine the reasons for the rates, nor does it allow the identification of clear strategies for improvement. This data allows for international comparisons of HH compliance rates and provides a benchmark in order to evaluate the impact of HH interventions, which will help to identify where resources or further research is required to improve HH compliance.

Conclusions

Despite the adoption of the WHO's HH guidelines worldwide, HH compliance remains suboptimal, particularly in low-income countries and among physicians. The data presented in this review may be used to provide an indication of ICU HH compliance rates reported in the published literature. It is hoped that this data will help contextualize ICU HH compliance rates when ICU are considering their own levels of compliance.

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Supplemental Digital Content 1 Search Strategy for Medline (Ovid)

- 1: exp Hand Hygiene/
- 2: Handwashing.ti,ab.
- 3: (Hand adj2 Cleansing).ti,ab.
- 4: (Hand adj2 Cleaning).ti,ab.
- 5: (Hand adj2 Decontamination).ti,ab.
- 6: (Hand adj2 Gel).ti,ab.
- 7: (Hand adj2 Saniti*).ti,ab.
- 8: (Hand adj2 Rub).ti,ab.
- 9: 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
- 10: exp Personnel, hospital/
- 11: exp Hospitals/
- 12: exp Critical care/
- 13: Health*.ti,ab.
- 14: Medic*.ti,ab.
- 15: 10 or 11 or 12 or 13 or 14
- 16: Compliance.ti,ab.
- 17: Adherence.ti,ab.
- 18: Rates.ti,ab.
- 19: Audit.ti,ab.
- 20: Observ*.ti,ab.
- 21: Opportunit*.ti,ab.
- 22: 16 or 17 or 18 or 19 or 20 or 21
- 23: 9 and 15 and 22

24: limit 23 to (english language and humans and yr="2009 -Current" and (adaptive clinical trial or classical article or clinical study or clinical trial, all or comparative study or controlled clinical trial or "corrected and republished article" or duplicate publication or equivalence trial or evaluation studies or historical article or journal article or observational study or randomized controlled trial or validation studies))

Study Design			Location - region Location - income class		Analysis	ICU type	HCW type	Sample size	Moments observed	Pooled # observations	Pooled % compliance	Moment 1 # observations	Moment 1 % compliance	Moment 2 # observations	Moment 2 % compliance	Moment 3 # observations	Moment 3 % compliance	Moment 4 # observations	Moment 4 % compliance	Moment 5 # observations	Moment 5 % compliance	Quality Notes score
Al-Dorzi et al., 2014 (45) Interve	vention	Saudi Arabia	Middle East and High income North Africa	Unspecified	Pooled	Medical-surgical ICU	Physicians, nurses, respiratory therapists	Unspecified	Moments 1-5	836	64.0	Unspecified	53.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	78.0	Unspecified	Unspecified	11
					Suberoup - HCWs Suberoup - HCWs	Medical-surgical ICU Medical-surgical ICU	therapists Physicians Nurses	Unspecified Unspecified	Moments 1-5 Moments 1-5	Unspecified Unspecified	68.0 62.0	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
	vention	Saudi Arabia	Middle East and High income	Unspecified	Subgroup - HCWs Pooled	Medical-surgical ICU Adult ICU	Respiratory therapists Nurses, physicians, other HCWs	Unspecified	Moments 1-5 Moments 1-5	Unspecified 874	62.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	10
Alhenn, Mhawsh, Yousef, & Aloudah. 2013 (46)	vention	Saudi Arabia	North Africa	Unspecified	Pooned	Adult ICU	Nurses, physicians, other HCWs	Unspecified	Moments 1-5	8/4	52.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	unspecified	Unspecified	Unspecified	Unspecified	10
Algudah, 2013 (46)					Suberoup - HCWs Subgroup - HCWs	Adult ICU Adult ICU	Nurses Physicians	Unspecified Unspecified	Moments 1-5 Moments 1-5	502 163	62.0 40.0	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	
					Subgroup - HCWs Subgroup - HCWs	Adult ICU Adult ICU	Physicians Respiratory therapists	Unspecified Unspecified	Moments 1-5 Moments 1-5	163 Unspecified	40.0 53.0	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Allegranzi et al., 2010 (33) Interve		Mali	Sub-Saharan Low income Africa	Not covert	Pooled	ICU	Unspecified	Unspecified	Moments 1-5	208	2.4	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	23
Allegranzi et al., 2013 (39) Interve	vention	Italy, Mali, Pakistan, Saudi	Europe & Central High income Law	Not covert	Pooled	ICU	Unspecified	Unspecified	Moments 1-5	28096	51.7	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	26
		Arabia	Asia; Sub-Saharan income; Low middle Africa; South Asia; income; High incom Middle East and	14;																		
			North Africa																			
Almaguer-Leyva et al., 2013 Observ (47)	rvational	Mexico	Latin America & Upper middle incom Caribbean	ne Unspecified	Subgroup - ICUs	Adult ICU	Unspecified	Unspecified	Moments 1-5	244	68.9	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	15
Observ		Saudi Arabia	Middle East and High income	Covert	Subgroup - ICUs Pooled	Paediatric ICU Adult surgical ICU, paediatric surgical ICI	Unspecified J. Physicians, nurses, others	Unspecified Unspecified	Moments 1-5 Moments 1-5	351 1995	61.5	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	20
Al-Nakhli, Baig, Goh, Sandokji, & Din, 2014 (48)			North Africa			coronary care unit, paediatric cardiology ICU																
Alp et al., 2014 (49) Interve	vention	Turkey	Europe & Central Upper middle incom	ne Unspecified	Pooled	Medical, general surgical, anaesthesiological and reanimation.	Unspecified	Unspecified	Moments 1-5	14	156	30.5 31	89 37	7.5 1	34 37	.3 52	24 25	.6 41	19 38	8.6 Unspecified	Unspecified	16
						neurosurgery																
Intervi Alp, Orhan, Kurkcu, Ersoy, &	vention	Turkey	Europe & Central Upper middle incom Asia	ne Unspecified	Subgroup - ICUs	Neonatal ICU	Unspecified	Unspecified	Moments 1-5	568	43.0	213.0	44.6	77.0	39.0	80.0	10.0	198.0	56.1	Unspecified	Unspecified	14
McLaws, 2015 (50)					Subgroup - ICUs	Paediatric ICU	Unspecified	Unspecified	Moments 1-5	364	22.0	99.0	21.0	68.0	10.0	90.0	7.0	107.0	45.0	Unspecified	Unspecified	
Alsubaie et al., 2013 (51) Observ	rvational	Saudi Arabia	Middle East and High income	Not covert	Pooled	Medical ICU, surgical ICU, paediatric ICU cardiac ICU, neonatal ICU	 Physicians, allied health staff, nurses, technicians, theranists, others 	242	Moments 1-5 Moments 1-3, Moments 4 and 1 combined	364 3940	42.4	Unspecified	21.0 37.3	Unspecified	10.0 74.3	Unspecified	7.0 74.5	Unspecified	Unspecified	Unspecified	Unspecified	24
						Paediatric ICU Medical ICU, surgical ICU, paediatric ICU cardiac ICU, neonatal ICU	(dietician, pharmacist, medical studen	τ,	combined	<i>.</i>												
					for the second second		parters cranaparters			007	25.6	11	11	11 mm	11	Harry W. J.	110000 100	110000	Users The S	11	11 mar 17 1	
					Subgroup - HCWs	Medical ICU, surgical ICU, paediatric ICU cardiac ICU, neonatal ICU	enysicians	Unspecified	Moments 1-3, Moments 4 and	887 5	35.6	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					Subgroup - HCWs	Medical ICU, surgical ICU, paediatric ICU cardiac ICU, neonatal ICU	Allied health staff	Unspecified	combined Moments 1-3, Moments 4 and 1	Unspecified	34.9	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
						cardiac ICU, neonatal ICU			combined							-	-		-			
					Subgroup - HCWs	Medical ICU, surgical ICU, paediatric ICU cardiac ICU, neonatal ICU	Nurses	Unspecified	Moments 1-3, Moments 4 and	2580 5	44.6	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					C. A		Technisian sharenist	11 marsh Word	combined		66.4	line of the '	Hanna (Bar)	the second first of	(January Way)	(and the set	line and the d	11 marsh 10 marsh	Deces Mark	the second first	Hanna Maria	
					Subgroup - HCWs	Medical ICU, surgical ICU, paediatric ICU cardiac ICU, neonatal ICU	rechnicians, therapists	unspecified	Moments 1-3, Moments 4 and	Unspecified 5	bb.4	Unspecified	unspecified	unspecified	unspecified	unspecified	unspecified	unspecified	unspecified	unspecified	Unspecified	
					Subgroup - ICUs	Paediatric ICU	Physicians, allied health staff, nurses,	Unspecified	combined Moments 1-3,	Unspecified	35.4	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
							technicians, therapists		Moments 4 and 1 combined													
					Subgroup - ICUs	Cardiac ICU	Physicians, allied health staff, nurses, technicians, therapists	Unspecified	Moments 1-3, Moments 4 and	Unspecified	37.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					Subgroup - ICUs	Medical ICU	Physicians, allied health staff, nurses,	line of the d	combined Moments 1-3,		43.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					Subgroup - ICOX	induction inco	technicians, therapists	unspecified	Moments 4 and 1 combined	5	43.5	Unipecined	Unspecified	Unspecified	Uniperineu	Unipecineu	Unspecified	Unspecified	Unspecified	Unipermed	Unipecined	
					Subgroup - ICUs	Neonatal ICU	Physicians, allied health staff, nurses,	Unspecified	Moments 1-3.	Unspecified	46.9	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
							technicians, therapists		Moments 4 and combined													
					Subgroup - ICUs	Surgical ICU	Physicians, allied health staff, nurses, technicians, therapists	Unspecified	Moments 1-3, Moments 4 and	Unspecified 5	49.4	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
Anistrationalist	ventino	Thailand	East Asia & Pacific Upper middle incom	no. Not count	Pooled	101		125	combined Moments 1-5	968	60.2	373.0	53.1	91.0	39.9	156.0	34.6	257.0	85.4	91.0	80.2	22
Apisarnthanarak, Intervi Eiamsitrakoon, & Mundy, 2015 (52)	Ventual		tan Anna Facilit. Opper model incom	ine rest covert	Poolea	1.0	Nurses, nurse assistants, physicians, housekeepers, radiology technicians, laboratory technicians		Montena 1-5	200	00.2	373.5	33.1	51.0	32.5	150.0	34.0	137.0	50.4	51.0	00.2	**
		Iran	Middle East & Upper middle incom		Dealed	101		line of the d	Moments 1-5	071	6.7	line of Fed	lines of Fed	(Income West	(Income West	Linear West	(Income Word	11West	(Income Mark	line of the d	Unspecified	18
Acael et al., 2015 (55) Ubserv	rvational	ingin .	Middle East & Upper middle incom North Africa	ne Not covert	Pooled	ICU	Physicians, nursing staff, students, allied health professionals, ancillary staff	Unspecified	Moments 1-5	8/1	6.7	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	18
Biswal et al., 2014 (54) Observ	rvational	India	South Asia Lower middle incom	ne Unspecified	Pooled	Cardiac care ICU, Cardiovascular and	Linconcilland	Unspecified	Moments 1-5	1239	28.1	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	13
						thoracic ICU, Gastroenterology ICU, Live ICU, Main ICU, Neurosurgery ICU, Neonatal ICU, Neonatal surgical ICU,																
						Paediatric ICU, Respiratory ICU, ,																
					Suberoup - ICUs Suberoup - ICUs	Cardiac care ICU Cardiovascular and thoracic ICU	Unspecified	Unspecified Unspecified	Moments 1-5 Moments 1-5	160 199	20.0 19.1	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	
					Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs	Gastroenteroloav ICU	Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Moments 1-5 Moments 1-5	160 199 123 69 182 121 83	7.3 8.6 9.3 9.9 66.2	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified	Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Urspecified Urspecified Urspecified Urspecified Urspecified	Unspecified	
					Subgroup - ICUs	Main ICU	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified	Moments 1-5	182	9.3	Unspecified	Unspecified	Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified Unspecified Unspecified Unspecified	
					Subgroup - ICUs	Neurosureerv ICU Neonatal ICU	Unspecified	Unspecified	Moments 1-5 Moments 1-5	83	66.2	Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified	
					Subgroup - ICUs Subgroup - ICUs	Neonatal surgical ICU Paediatric ICU	Unspecified Unspecified	Unspecified Unspecified	Moments 1-5 Moments 1-5	98 84	27.5 25.0	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Brotfain et al., 2017 (55) Observ	ervational	Israel	Middle East & High income North Africa	Not covert (direct observation) and	Subgroup - ICUs t Subgroup - Not covert	Respiratory ICU General ICU	Unspecified Nurses, physicians, auxiliary workers	Unspecified Unspecified	Moments 1-5 Moments 1-5	120 1183	38.3 36.8	Unspecified 65.0	Unspecified 29.2	Unspecified 72.0	Unspecified 16.7	Unspecified 114.0	Unspecified 32.5	Unspecified 75.0	Unspecified 70.7	Unspecified 131.0	Unspecified 57.5	24
			North Africa	observation) and Covert (CCTV																		
				observation)																		
					Subgroup - Covert	General ICI	Nurses, physicians, auxiliary workers	linsner#od	Moments 1-5	1070	23.8	33.0	54.5	54.0	13.0	122.0	24.6	70.0	68.6	78.0	57.7	
Changest al. 2010 (CC)	vention-*	1154	North America 18th Income	Count																		17
Chang et al., 2016 (56) Observ Chavali, Menon, & Shukla, Observ	a vacional rivational	USA India	North America High income South Asia Lower middle incom	Covert ne Covert	Pooled Pooled	ICU ICU	Unspecified Nurses, allied health staff	Unspecified 38	Moments 1-5 Moments 1-5	509 1500	69.2 78.0	188.0 Unspecified	54.6 Unspecified	42.0 Unspecified	47.6 Unspecified	42.0 Unspecified	42.9 Unspecified	92.0 Unspecified	62.0 91.0	145.0 Unspecified	67.6 Unspecified	17 18
2014 (57)					Suberoup - HCWs	icu	Nurses	28	Moments 1-5	1132	69.0	408.0	63.0	170.0	39.0	273.0	93.0	160.0	91.0	121.0	50.0	
Clack, Scotoni, Observ	rvational	Switzerland	Europe & Central High income	Not covert	Subgroup - HCWs Subgroup - HCWs Pooled	ICU Trauma ICU, cardio-surgical ICU, general surgical ICU	Allied health staff Nurses, physicians	10	Moments 1-5 Moment 2	368 217.0	86.9 1.4	85.0 Unspecified	92.0 Unspecified	75.0 217.0	89.0 1.4	88.0 Unspecified	96.0 Unspecified	66.0 Unspecified	81.0 Unspecified	54.0 Unspecified	70.0 Unspecified	20
Clack, Scotoni, Observ Wolfensberger, & Sax, 2017 (58)			Asia																			
					Suberoup - ICUs Subgroup - ICUs	Trauma ICU Cardio-surgical ICU	Nurses Nurses	4	Moment 2 Moment 2	84.0 132.0	0.0	Unspecified Unspecified	Unspecified Unspecified	84.0 132.0	0.0 2.3	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Pitcash and the second		found that "	Middle Fact & High income	Both	Subgroup - ICUs Subgroup - ICUs	Cardio-surgical ICU General surgical ICU	Physicians	2	Moment 2 Moment 2	1.0	0.0	Unspecified 42.8 Unspecified	Unspecified	132.0	0.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	22
El-Saed et al., 2018 (59) Observ	evation	Saudi Arabia	Middle East & High income North Africa	Rotu	Lovert	100	Nurses, prijskilens, ooner rikeva	unspecified	Moments 1-5			42.0 Onspecified	Unspecified	unspecified	Unspecified	unspecified	unspecified	unspecified	unspecified	unspecified	unspecified	22
Erasmus et al., 2010 (60) Interve	vention	Netherlands	Europe & Central High income	Not covert	Overt Pooled	ICU	Nurses, physicians, other HCWs Nurses	Unspecified 8	Moments 1-5 Moments 1-5	141	10.7	91.2 Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	20
Eveillard et al., 2009 (61) Observ		France	Asia Europe & Central High income	Unspecified	Pooled	Medical ICU, surgical ICU	Unspecified	Unspecified	Moments 1-5	903	47.5	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	14
			Aria	Not covert	Pooled	Medical-surgical ICU	Unspecified	Unspecified	Moments 1-5		60.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	15
FitzGerald, Moore, & Observ Wilson, 2013 (62) Fonguh, Uwineza, Catry, & Interve	vention	Relation	Asia Furne & Central High Income	Unspecified	2013 Pooled	101	Nurses, nursing assistants, physicians,	Linspection	Momente 1-5	18898	69.8	lingoorified	62.7	Unspecified	56.9	Linspectition	77.1	Unspecified	81.8	Lingsperified	65.6	12
Simon, 2016 (63)			Asia	onspective			Nurses, nursing assistants, physicians, physiotherapists, others	Shapediliku	monetth 1-3	100.00	02.0	omptotitis	wa. /	onspecting		onspectived	****	onspecting		onspective	63.6	
					2015 Pooled	icu	Nurses, nursing assistants, physicians,	Unspecified	Moments 1-5	18775	72.0	Unspecified	64.1	Unspecified	59.1	Unspecified	77.6	Unspecified	82.6	Unspecified	69.9	
							physiotherapists, others															
					2013 Subgroup - HCWs	icu	Nurses	Unspecified	Moments 1-5	Unspecified	73.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					2013 Subgroup - HCWs	ICU	Nursing assistants	Unspecified	Moments 1-5	Unspecified	67.1	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					2013 Subgroup - HCWs	icu	Physicians	Unspecified	Moments 1-5	Unspecified	59.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					2013 Subgroup - HCWs	ICU	Physiotherapists	Unspecified	Moments 1-5	Unspecified	73.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					2013 Subgroup - HCWs	icu	Others	Unspecified	Moments 1-5	Unspecified	53.5	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					2015 Subgroup - HCWs		Nurses	Unspecified	Moments 1-5	Unspecified	75.2	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
					2015 Subgroup - HCWs		Nursing assistants	Unspecified	Moments 1-5	Unspecified	80.0	Unspecified	Unspecified	lingneritied	Unspecified	Unspecified	Lincoprified	Unspecified	Linsnerified	Unspecified	Unspecified	
					2013 Saugroup - HCWS			anapedited	monefils 1-0	onquetined	00.0	unsectied	onspectied	unspectined	CHAPTELING	onspecified	onspecified	onspective	onspective	onspectinet	onspectingo	

				2015 Subgroup - HCW	is ICU	Physicians	Unspecified	Moments 1-5	Unspecified	61.2	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
				2015 Subgroup - HCW	is icu	Physiotherapists	Unspecified	Moments 1-5	Unspecified	72.4	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
				2015 Subgroup - HCW	is iCU	Others	Unspecified	Moments 1-5	Unspecified	63.5	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
Fuller et al., 2011 (64)	Observational	United Kingdom	Europe & Central High income Covert	Pooled	Intensive therapy unit	Unspecified	Unspecified	Moments 1-5	1410	52.1	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	24
Hagel et al., 2015 (65)	Observational	Germany	Asia Europe & Central High income Not covert	Pooled	Anaesthesiological-surgical ICU	Nurses, physicians, students, others	Unspecified	Moments 1-5	3978	51.0	562.0	45.0	658.0	25.0	360.0	57.0	853.0	73.0	1545.0	51.0	23
			Asia	Subgroup - HCWs	Anaesthesiological-surgical ICU	Nurses	Unspecified	Moments 1-5	3229	52.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
				Subaroup - HCWs Subaroup - HCWs	Anaesthesiological-surgical ICU Anaesthesiological-surgical ICU	Physicians Students	Unspecified Unspecified	Moments 1-5 Moments 1-5	517 32	42.0 56.0	Unspecified	Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	
				Subgroup - HCWs	Anaesthesiological-surgical ICU	Others (e.g. x-ray technicians,	Unspecified	Moments 1-5	200	33.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	
Hitoto et al., 2011 (66)	Intervention	France	Europe & Central High income Unspecified	Pooled	Medical ICU, surgical ICU	ohvsiotheraoists) Unspecified	Unspecified	Moments 1-5	422	44.8	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	19
Karaaslan et al., 2014 (67)	Observational	Turkey	Asia Europe & Central Upper middle income Not covert	Pooled	Paediatric ICU, neonatal ICU	Nurses, doctors	Unspecified	Moments 1-5	704	37.0	162.0	43.2	118.0	8.5	98.0	18.1	88.0	68.1	238.0	43.2	16
			Asia	Subgroup - HCWs	Paediatric ICU, neonatal ICU	Nurses	Unspecified	Moments 1-5	468	41.4	114.0	43.8	87.0	7.0	78.0	16.8	67.0	74.6	123.0	60.1	
Kolola & Gezahegn, 2017	Observational	Ethiopia	Sub-Saharan Lowincome Covert	Subgroup - HCWs Pooled	Paediatric ICU, neonatal ICU Neonatal ICU	Doctors Unspecified	Unspecified Unspecified	Moments 1-5 Moments 1-5	197	31.9 27.3	41.0 Unspecified	48.7 Unspecified	32.0 Unspecified	12.5 Unspecified	22.0 Unspecified	22.7 Unspecified	18.0 Unspecified	55.5 Unspecified	84.0 Unspecified	28.5 Unspecified	22
(34) Kouni et al., 2014 (68)	Observation	Groate	Africa Europe & Central High income Not covert	Subgroup - ICUs	Neonatal ICU	Medical staff, nursing staff	Unspecified	Moments 1-5	130	64.6	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	20
Koumet at., 2014 (68)	Observation	Greece	Asia Not covert		Paediatric ICU					64.6		Unspecified	Onspecified		Unspecined		onspecified			onspecified	10
				Suberoup - ICUs Subgroup - HCWs	Neonatal ICU, paediatric ICU	Medical staff. nursine staff Medical staff	Unspecified Unspecified	Moments 1-5 Moments 1-5	164 97	64 43.3	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Kurtz, 2017 (69)	Observational	USA	North America High income Not covert	Subaroup - HCWs Pooled	Neonatal ICU. paediatric ICU ICU	Nursing staff Nurses	Unspecified 64	Moments 1-5 Moment 1,	197 3620	74.6 64.1	Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified	18
Kuruno, Kasahara, &	Intervention	Japan	East Asia & Pacific High income Not covert	Pooled	ICU	Nurses	Unspecified	Moment 5 Moments 1-5	1221	16.1	Unspecified	6.0	Unspecified	3.3	Unspecified	37.0	Unspecified	37.0	Unspecified	38.2	16 Compliance for Moments 1. 3 and 4 estimated from Figure 2
Mikasa, 2017 (70) Laskar et al., 2018 (71)	Intervention	terite.	South Asia Lower middle income Unspecified	Protect	ICU ICU	Physicians, nurses, housekeeping staff		Moments 1-5	33		1.2 Unspecified		i0 Unspecified		.2 Unspecified		2 Unspecified		50 Unspecified		Compliance for Moments 1, 4 and 5 estimated from Figure 2
		India		Pooled											z Unspeched		.2 Unspecified				
Lebovic, Siddiqui, & Muller, 2013 (72)	Observational	Canada	North America High income Unspecified	Pooled	ICU	Unspecified	Unspecified	Moments 1-3, Moments 4 and	1724 5	48.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	21
Lee et al., 2014 (73)	Intervention	South Korea	East Asia & Pacific High income Unspecified	Subgroup - HCWs	ICU	Doctors	Unspecified	combined Moments 1-5	46	19.6	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	19
				Suberoup - HCWs	101	Nurrer	Unrestind	Momente 1.5	84	57.1	Hereerified	Uncontined	Uncoor Sod	UnroorRod	Herearified	Hereerilled	Uncontend	Uncoording	Hereoriad	Hereerified	
Levin, Golovanevski, Moses Sprung, & Benerson, 2011	Observation	israel	Middle East & High income Covert	Pooled	ICU General ICU	Nurses, physicians	Unspecified	Moments 1-5 Moments 1-5	702	58.4	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified Unspecified	16
Sprung, & Benenson, 2011 (74)			North Africa																		
				Subaroup - HCWs Subgroup - HCWs	General ICU General ICU	Nurses Physicians	Unspecified Unspecified	Moments 1-5 Moments 1-5	394 308	62.7 52.9	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Lin, Yang, & Lai, 2014 (75)	Observation	Taiwan	East Asia & Pacific High income Unspecified	Pooled	icu	Nurses	Unspecified	Moments 1-5	7	59 58.	1.7 Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspeched	14
				Subgroup - ICU Subgroup - ICU	Medical ICU Surgical ICU	Nurses Nurses	Unspecified	Moments 1-5 Moments 1-5			1 Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Manage of A second	Ohana	Barra 1	Latin America & Upper middle income Not covert	Subaroup - ICU Subgroup - ICU	Sureical ICU Respiratory care unit	Nurses Nurses Doctors, nurses, respiratory therapists	Unspecified	Moments 1-5 Moments 1-5	1078	93 54. 28 71. 70.7	.9 Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified	10
Magnus et al., 2015 (76)	Ubservational	Brazil	Latin America & Upper middle income Not covert Caribbean	Pooled	ICU.	Doctors, nurses, respiratory therapists and other HCW inc. radiology technicians and laboratory technicians	, Unspecified	Moments 1-5	1078	70.7	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	19
						technicians and laboratory technician															
Malundo & Berba, 2017 (77)	Observational	Philippines	East Asia & Pacific Lower middle income Not covert	Pooled	ICU	Doctors, nurses, students	Unspecified	Moments 1-5	337	15.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	25
Marra et al., 2013 (78)	Observational	Brazil	Latin America & Upper middle income Not covert Caribbean	Pooled	Medical-Surgical	Physicians, nurses, respiratory	Unspecified	Moments 1-5	3895	36.9	1497	33.3	228	40.8	222	55.0	1032	43.1	916	30.5	17
			Canobian			therapists, medical interns, and other HCW inc. radiology technicians and Inheratory technicians															
						aboratory decimicants															
				Subgroup - HCWs Subgroup - HCWs	Medical-Surgical Medical-Surgical	Nurse Physician	Unspecified Unspecified	Moments 1-5 Moments 1-5	2981 436 316	39.8 18.8	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
				Subaroup - HCWs Subgroup - HCWs	Medical-Surgical Medical-Surgical	Respiratory Therapist Other	Unspecified Unspecified	Moments 1-5 Moments 1-5	316	37.3	Unspecified	Unspecified	Unspecified Unspecified	Unspecified	Unspecified	Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	Unspecified Unspecified	
Marra, Moura, Paes, dos Santos, & Edmond, 2010	Observational	Brazil	Latin America & Upper middle income Not covert Caribbean	Pooled	Medical-Surgical	Unspecified	Unspecified	Moments 1-5	2249	62.3	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	18
(79) Mazi, Senok, Al-Kahidy, & Abdullah, 2013 (80)	Intervention	Saudi Arabia	Caribbean Middle East and High income Not covert North Africa	Pooled	ICU, Neonatal ICU, Burn unit, Kidney centre	Nurses, Physicians, Other	Unspecified	Moments 1-5	409	67	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	12
(79) Mazi, Senok, Al-Kahldy, &	Intervention	Saudi Arabia	Middle East and High income Not covert	Subgroup - ICLI	centre ICU Neonatal ICU	Nurses. Physicians.Other	Unreactford	Moments 1-5 Moments 1-5	54 162	39.0 88.0	Unspecified	Unspecified	Uncoor Sod	UnroorRod	Unspecified	Hereerilled	Uncontend	Uncoording	Unspecified	Unspecified	12
(79) Mazi, Senok, Al-Kahldy, &	Intervention	Saudi Arabia	Middle East and High income Not covert	Subgroup - ICLI	centre ICU Neonatal ICU	Nurses. Physicians.Other	Unreactford	Moments 1-5 Moments 1-5	54 162	39.0 88.0	Unspecified	Unspecified	Uncoor Sod	UnroorRod	Unspecified	Hereerilled	Uncontend	Uncoording	Unspecified	Unspecified	12
(79) Mazi, Senok, Al-Kahldy, &	Intervention	Saudi Arabia	Middle East and High income Not covert		centre ICU Neonatal ICU Burn unit Kidney Center ICU, Neonatal ICU, Burn unit, Kidney	Nurses, Physicians.Other		Moments 1-5		39.0	Unspecified	Unspecified			Unspecified				Unspecified	Unspecified	12
(79) Mazi, Senok, Al-Kahldy, &	Intervention	Saudi Arabia	Middle East and High income Not covert	Subaroup - ICUs Subgroup - ICUs Subaroup - ICUs Subgroup - ICUs	centre ICU Neonatal ICU	Nurses. Physicians. Other Nurses, Physicians, Other Nurses. Physicians, Other Nurses, Physicians, Other	Unspecified Unspecified Unspecified Unspecified	Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5	54 162 110 83 225	39.0 88.0	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	UnroorRod	Unspecified	Hereerilled	Uncontend	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	12
(79) Mazi, Senok, Al-Kahldy, &	Intervention	Saudi Arabia	Middle East and High income Not covert	Suberoup - ICUs Subgroup - ICUs Suberoup - ICUs Subgroup - ICUs Subgroup - HCWs Subgroup - HCWs	centre ICU Neonatal ICU Burn unit Kidney Center ICU, Neonatal ICU, Burn unit, Kidney centre	Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses	Unspecified Unspecified Unspecified Unspecified Unspecified	Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5	54 162 110 83 225	39.0 88.0 70.0 43.0 63.0	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified	22
(79) Mazi, Senak, Al-Kahldy, & Abdullah, 2013 (80)			Middle East and High Income Not covert North Africa	Suberoup - ICUs Suberoup - ICUs Suberoup - ICUs Suberoup - ICUs Suberoup - ICWs Suberoup - HCWs Suberoup - HCWs	centre ICU Necenzial ICU Burn unit Kidarey Center ICU, Necenztai ICU, Burn unit, Kidney centre ICU, Necenztai ICU, Burn unit, Kidney centre Centre Cotto Centre Cotto Centre	Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses Physicians Other	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5	54 162 110 83 225 108 76	39.0 88.0 70.0 43.0 63.0 56.0	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	12
(79) Mazi, Senok, Al-Kahldy, &		Saudi Arabia Canada	Middle East and High income Not covert	Suberoup - ICUs Subgroup - ICUs Suberoup - ICUs Subgroup - ICUs Subgroup - HCWs Subgroup - HCWs	centre ICU Neonatal ICU Burn unit Kidney Center ICU, Neonatal ICU, Burn unit, Kidney centre ICU, Neonatal ICU, Burn unit, Kidney centre ICU, Neonatal ICU, Burn unit, Kidney	Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses Physicians	Unspecified Unspecified Unspecified Unspecified Unspecified	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3, Moments 1-3,	54 162 110 83 225 108 76	39.0 88.0 70.0 43.0 63.0 56.0	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	12
199) Mai, Senok, Al-Kahóy, & Abdulah, 2013 (80) Mukerji et al., 2013 (81)	Intervention		Middle East and High Income Not covert North Africa	Suberoup - ICUs Suberoup - ICUs Suberoup - ICUs Suberoup - ICUs Suberoup - ICWs Suberoup - HCWs Suberoup - HCWs	centre ICU Necenzial ICU Burn unit Kidarey Center ICU, Necenztai ICU, Burn unit, Kidney centre ICU, Necenztai ICU, Burn unit, Kidney centre Centre Cotto Centre Cotto Centre	Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses, Physicians, Other Nurses Physicians Other	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5 Maments 1-5	54 162 110 83 225 108 76 509 5	39.0 88.0 70.0 43.0 63.0 56.0	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	22 29 20
199) Mai, Senok, Al-Kahldy, & Abdulah, 2013 (80) Mukerji et al., 2013 (81) Murri, Duke, Kinney, Daky & Scenarto, 2015 (82)	Intervention	Canada Indonesia	Mode East and High Income Not covert North America High Income Not covert East Ania & Pacific Lower model income Not covert	Suberous - ICUs Suberous - ICWs Pooled Pooled	centre ICU ICU Nexus anti- Kishop-Center ICU, Neostati ICU, Burn unit, Kidney centre ICU, Neostati ICU, Burn unit, Kidney centre Cut, Neostati ICU, Burn unit, Kidney centre Neonatal ICU Padiatric ICU	Nurse: Physicians.Other Nurse, Physicians.Other Nurse, Physicians.Other Nurses Physicians Other Unspecified Dectors, Hurses	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-3 Moments 1-3 Moments 1-5	54 162 110 83 225 108 76 509 5	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 9.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 67.0	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
199) Mai, Senok, Al-Kahóy, & Abdulah, 2013 (80) Mukerji et al., 2013 (81)	Intervention	Canada	Mode East and High Income Not covert from Africa North America High Income Not covert	Subarrous - ICUs Subarrous - ICUs Subarrous - ICUs Subarrous - ICUs Subarrous - ICUs Subarrous - ICUs Subarrous - ICWs Subarrous - ICWs Subarrous - ICWs Subarrous - ICWs Pooled Pooled	entre ICU ICU Neonaria Kistope Center ICU, Neonatal ICU, Burn unit, Kidney centre ICU, Neonatal ICU, Burn unit, Kidney centre ICU, Neonatal ICU, Burn unit, Kidney Centre Neonatal ICU Paesitaric ICU Medical-Surgical	Nurss, Phoicias, Other Nurss, Physicias, Other Nurss, Physicias, Other Nurss, Physicias Other Unspecified Dotor, Nurss, Physician, ourse, nurse ables	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 347	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-3 Moments 1-5	54 162 110 83 225 108 76 509 5 596 4949	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7 39.2	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 9.0 Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
199) Mai, Senok, Al-Kahldy, & Abdulah, 2013 (80) Mukerji et al., 2013 (81) Murri, Duke, Kinney, Daky & Scenarto, 2015 (82)	Intervention	Canada Indonesia	Mode East and High Income Not covert North America High Income Not covert East Ania & Pacific Lower model income Not covert	Suberous - ICUs Suberous - ICWs Pooled Pooled	centre (CL) (CL) March (CL) March (CL)	Nouse Physical Ober Hunse, Physical Ober Hunse, Physical Ober Hunse, Physical Ober Nurse, Physical Ober Unspecified Doctor, Nurse Physical , nurse, nurse alles Physical , nurse, nurse alles Physical , nurse, nurse alles	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-3 Moments 1-3 Moments 1-5	54 162 110 83 225 108 76 5 509 596 4949 1554	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7	Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 9.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 67.0	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
10) Mail, Sonik, Air Ander, B. Anduba, 2013 (R) Mukerji et al., 2013 (R) Murri, Dale, Kloney, Daley & Scenaric, 2015 (R2) Missuert al., 2017 (R3)	Intervention Intervention Observational	Canada Indonesia Itały	Mode East and High Income Not covert form Artica North America High Income Not covert East Ault & Pacific Lower mode Income Not covert Europe & Central High Income Not covert Alse	Subercus - ICLIs Subercus - ICLIs Subercus - ICLIs Subercus - ICLIs Subgroup - ICLIs Subgroup - ICLIs Subgroup - ICLIS Subgroup - ICLIS Pooled Pooled Subgroup - ICLIS	centre CGU CGU TGU TGU TGU TGU TGU TGU TGU T	Nouse Physical Ober Hunse, Physical Ober Hunse, Physical Ober Hunse, Physical Ober Nurse Physical Ober Unspecified Doctor, Nurse Physical ober of the set of the set Physical ober of the set of the s	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 347	Moments 1-5 Moments 1-5 Moments 2-5 Moments 2-5 Moments 2-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-5 Moments 1-5 Moments 1-5	54 162 110 83 225 108 76 5 509 596 4949 1554	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7 39.2 35.2	Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified 83.4	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 9.0 Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 67.0 Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0 Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified 0.00000000000000000000000000000000000	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified SS.1	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
199) Mai, Senok, Al-Kahldy, & Abdulah, 2013 (80) Mukerji et al., 2013 (81) Murri, Duke, Kinney, Daky & Scenarto, 2015 (82)	Intervention Intervention Observational	Canada Indonesia Itały	Mode East and High Income Not covert North America High Income Not covert East Ania & Pacific Lower model income Not covert	Subaroua - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - HCWs Subgroup - HCWs Subgroup - HCWs Paoled Pooled Pooled Subgroup - HCWs	centre (CL) (CL) March (CL) March (CL)	Nouse Physical Ober Hunse, Physical Ober Hunse, Physical Ober Hunse, Physical Ober Nurse Physical Ober Unspecified Doctor, Nurse Physical ober of the set of the set Physical ober of the set of the s	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 347	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5	54 162 110 83 225 108 76 5 509 596 4949 1554	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7 39.2 35.2	Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified 38.4 42.4	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified G7.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0 Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified Unspecified 0.52.0 Unspecified 67.3 63.2	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified SS.1	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
10) Mail, Sonik, Air Ander, B. Anduba, 2013 (R) Mukerji et al., 2013 (R) Murri, Dale, Kloney, Daley & Scenaric, 2015 (R2) Missuert al., 2017 (R3)	Intervention Intervention Observational	Canada Indonesia Itały	Mode East and High Income Not covert form Artica North America High Income Not covert East Ault & Pacific Lower mode Income Not covert Europe & Central High Income Not covert Alse	Subaroua - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - HCWs Subgroup - HCWs Subgroup - HCWs Paoled Pooled Pooled Subgroup - HCWs	centre (CL) (CL) March (CL) March (CL)	Nouse Physical Ober Hunse, Physical Ober Hunse, Physical Ober Hunse, Physical Ober Nurse Physical Ober Unspecified Doctor, Nurse Physical ober of the set of the set Physical ober of the set of the s	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 347	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5	54 162 110 83 225 108 76 5 509 596 4949 1554	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7 39.2 35.2	Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified 38.4 42.4	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified G7.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0 Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified Unspecified 0.52.0 Unspecified 67.3 63.2	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified SS.1	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
Muderaj et al., 2013 (BR) Muderaj et al., 2013 (BR) Muderaj et al., 2013 (BR) Muderaj et al., 2013 (BR) Mudera, 2015 (BR) Muse et al., 2015 (BR) Otheras, Gama, & Paula,	Intervention Intervention Observational Observational	Canada Indonesia Italy Jamaica	Mode bot and High Roome Not covert Norm Arica High Income Not covert Exit Avail Pacific Lower middle income Not covert Caribbaan Not Covert Caribbaan Department Department Caribbaan Covert Caribbaan Covert Caribbaan Covert	Subaroua - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - HCWs Subgroup - HCWs Subgroup - HCWs Paoled Pooled Pooled Subgroup - HCWs	centre (CL) (CL) March (CL) March (CL)	Nursa: Photolas: Other Nursa: Phytolas: Other Nursa: Phytolas: Other Nursa: Phytolas: Other Other Ungacified Doctor, Nurses Phytolas: nurse akks Phytolas:	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 347	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-3 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5	54 162 110 83 225 108 76 5 509 596 4949 1554	39.0 88.0 70.0 43.0 63.0 56.0 65.0 76.0 11.7 39.2 35.2	Unspecified Unspecified Unspecified Unspecified Unspecified 242.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified 38.4 42.4	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified G7.0 Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 34.0 Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified Unspecified 0.52.0 Unspecified 67.3 63.2	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified SS.1	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	
Multiple et al., 2013 (EG) Multiple et al., 2013 (EG) Multiple et al., 2013 (EG) Muntiple et al., 2015 (EG)	Intervention Intervention Observational Observational	Canada Indonesia Italy Jamaica	Madib bai and Migh Income Hot cavet North Africa High Income Not cavet East Asia & Pacific Lever Hiddle Income Not cavet Asia Control High Income Not cavet Asia America B. Upper middle Income Covet Caribban	Subaroua - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICUs Subgroup - ICWs Subgroup - ICWs Pooled Pooled Pooled Pooled Pooled	center Carlo Carlo Carlo Carlo Barr untit Callow Cantor Callow Carlo Callow Carlo Callow Carlo Callow Carlo Callow Callow Callow Carlo Carlo Medical Surgical Medical Surgical Medical Surgical Medical Surgical Medical Surgical	Nonse Physical Other Hurses, Physical Other Hurses, Physical Other Hurses, Physical Other Hurses, Physical Other Hurses Other Unspecified Dectors, Nurses Physical State Physical State Hurses Dectors, Nurses Dectors, Nurses Hurses Dectors, Nurses Hurses Dectors, Nurses	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5 Moments 1-5	54 162 225 225 50 50 50 60 4949 110 1564 3104 256	39.0 88.0 70.0 43.0 56.0 65.0 76.0 76.0 11.7 39.2 39.2 35.5 35.5	Unicectified Unicectified Unicectified Unicectified Unicectified Unicectified 242.0 Unicectified Unicectified Unicectified Unicectified Unicectified	Unseefind Unseefind Unseefind Unseefind Unseefind Unseefind Unseefind Unseefind 38.4 Unseefind 32.4 32.0 Unseefind 42.4 37.0 Unseefind	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled Unsectled	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unissectified Unissectified Unissectified Unissectified Unissectified Unissectified 82.0 Unissectified 47.3 63.2 100.0 Unispectified	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled Unsectiled	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	20 17 17
Mailer, Sonz, Al-Kahly, & Adouban, 2013 (EG) Muderiji et al., 2013 (EG) Muderiji et al., 2013 (EG) Muduriji et al., 2015 (EG) Objevera, Gamma, & Prada, 2017 (EG)	Intervention Intervention Observational Observational	Canada Indonesia Italy Jamaica Brazi	Mode baland High Roome Net Covert North Africa High Income Not Covert East Acia Pacific Lever middle Income Not Covert Caribbean Upper middle Income Covert Caribbean Upper middle Income Covert Caribbean	Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS Pooled Pooled Pooled Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS Subtroup - ICUS	center Construction Construction Development delays (cataset) delays (cataset) delays (cataset) delays (cataset) delays (cataset) delays (cataset) delays (cataset) Presistore (Cataset) Medical Sorgical Medical	Nucsa, Physical Shar Nucsa, Physical Shar Nursa, Physical Shar Nursa, Physical Shar Nursa, Physical Shar Other District Shares District Shares District Shares Physical Shares Physical Shares Shares Physical Shares Shares Shares Physical Shares Sha	Unseedfied Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 347 118 395 34 46	Monents 1.5 Moments 1.5	54 162 10 83 225 108 76 596 596 596 4949 1564 3104 281 110 956 UnresetTed	39.0 88.0 70.0 41.0 56.0 56.0 65.0 76.0 11.7 39.2 35.2 40.6 45.2 35.5 19.3	Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified Unisecified	Unseefind Unseefind Unseefind Unseefind Unseefind Unseefind Unseefind Unseefind 32.4 Unseefind 32.4 32.0 Unseefind 42.4 37.0 Unseefind	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled Urseefiled	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified 34.0 Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unspecified Unspecified Unspecified Unspecified Unspecified 82.0 Unspecified 67.3 63.2 Unspecified Unspecified	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unsectled Unspected	20 27 17 18
Makerji et al., 2013 (BI) Mukerji et al., 2013 (BI) Mukerji et al., 2013 (BI) Murer, Dale, Krimer, Calve, Si Sonarra, 2015 (BI) Murer, Editer, 2017 (BI) Microt et al., 2017 (BI) Oliverer, Game, & Priud, 2017 (BI) Oliverer, Game, & Priud, 2017 (BI) Phone et al., 2015 (BI)	Intervention Intervention Observational Observational Intervention	Canada Indonesia Italy Jamaica Brazil Vietnam	Mode East and High Roome Not covert Norm Arica High Roome Not covert East Asia & Pacific Lower model income Not covert Caribbaan Latin Anerca & Upper model income Not covert Caribbaan Latin Anerca & Upper model income Not covert Caribbaan East Asia & Pacific Lower model income Not covert Caribbaan East Asia & Pacific Lower model income Not covert Caribbaan East Asia & Pacific Lower model income Not covert Caribbaan East Asia & Pacific Lower model income Not covert	subgroups - KGIs Subgroups - KGIs Subgroups - KGIs Subgroups - KGIs Subgroups - KGIs Subgroups - KGIs Paceled Paceled Paceled Subgroups - KGWs Paceled Subgroups - KGWs Paceled Subgroups - KGWs Subgroups - KGWs Subgroups - KGWs Subgroups - KGWs	centre CGU	Nucsa, Process, Sheri Nursa, Process, Derri Nursa, Process, Derri Nursa, Process, Derri Nursa, Obar Obar Obar Obar Obar, Nursa, Nursa, Nursa Salos Process, Nursa, Salos Process, Nursa, Salos Process, Alanse, Process, Alanse Nursa, Salos, Process, Alanse Nursa, Salos, Process, Alanse Alanse, Nursa, Salos, Process, Alanse, Alanse Manager, Salos, Process, Alanse Alanse, Alanse, Alanse, Alanse Manager, Salos, Process, Alanse Alanse, Alanse, Alanse, Alanse, Alanse Manager, Salos, Alanse,	Unseefined Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified 46 46 27 27	Moments 1.5 Moments 1.8 Moments 1.8 Moments 1.5 Moments 1.5	54 162 110 225 225 509 550 550 550 550 550 550 550 550 55	39.0 88.0 70.0 40.0 56.0 65.0 76.0 76.0 76.0 39.2 35.5 11.7 35.2 35.5 19.3 64.1 17.8 64.0	UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied UnisecTied	Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield Unseefield	Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified	Unsectiled Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide Unsectide	Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified Unsecified	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified Unsectified	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	Unsectied Unspectied Unspectied Unspected	Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified Unspecified	20 17 17 18 19 Pooled complance estimated from Figure 1
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(rauth. 2017 (95)		Germany	Europe & Central High income Asia	Not covert	Pooled	Internal ICU, Surgical ICU	Nurse, Doctor, Other (inc. physiotherpist, transportation staff	Unspecified	Moments 1-5	1896	42.6	Unspecified	33.8	Unspecified	24.8	Unspecified	42.5	Unspecified	66.4	Unspecified	49.9	20	
					Subgroup - ICUs	Internal ICU	Nurse, Doctor, Other (inc. physiotherpist, transportation staff	Unspecified	Moments 1-5	803	43.3	Unspecified	32.1	Unspecified	24.6	Unspecified	40.0	Unspecified	65.3	Unspecified	52.0		
					Subgroup - ICUs	Surgical ICU	Nurse, Doctor, Other (inc. physiotherpist, transportation staff	Unspecified	Moments 1-5	1093	42.1	Unspecified	35.0	Unspecified	24.8	Unspecified	44.2	Unspecified	67.5	Unspecified	48.4		
Süzük, Edis, Çalık, Akdoğan, Öbser & Ünal, 2015 (96)	servational	Turkey	Europe & Central Upper middle inco Asia	me Unspecified	Pooled	ICU	Physicians, Nurses	30	Moments 1-5	248	70.2	43.0	67.4	19.0	36.8	31.0	74.2	72.0	70.8	83.0	77.1	19	
					Subgroup - HCWs	ICU	Physicians	5	Moments 1-5	Unspecified	60.8	Unspecified	60.0	Unspecified	100.0	Unspecified	60.0	Unspecified	52.4	Unspecified	64.0		
					Subgroup - HCWs	ICU	Nurses	25	Moments 1-5	Unspecified	74.1	Unspecified	71.4	Unspecified	25.0	Unspecified	81.0	Unspecified	78.4	Unspecified	82.8		
Faneja & Mishra, 2015 (97) Interv	tervention	India	South Asia Lower middle inco	me Not covert	Pooled	ICU	Nursing staff	106	Moment 1, Moment 4, Moment 5	462	52.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	15	
Thu et al., 2015 (98) Interv	tervention	Vietnam	East Asia & Pacific Lower middle inco	me Unspecified	Pooled	Main ICU, Critical care unit	Doctors, Nurses, Technicians, Others (inc physiotherapists and medical students)	Unspecified	Moments 1-5	3010	25.7	1049.0	17.0	412.0	31.8	263.0	56.7	936.0	29.2	350.0	2.3	21	
					Subgroup - HCWs	Main ICU. Critical care unit	Doctors	Unspecified	Moments 1-5		26.6	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified		
					Subgroup - HCWs	Main ICU, Critical care unit	Nurses	Unspecified	Moments 1-5	1923	26.3	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified		
Fschudin-Sutter, Sepulcri, Obser Dangel, Schuhmacher, & Nidmer, 2015 (99)	oservational	Switzerland	Europe & Central High income Asia	Not covert	Pooled	icu	Nurses, Doctors, Others	Unspecified	Moments 1-5	193	100.0	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	15	
van der Kool et al., 2018 Interv 100)	tervention	11 European countries; Germany and the Netherlands excluded	Europe & Central Unspecified Asia	Not covert	Pooled	Adult ICU	Nurses, Doctors, Auxilary staff, other Healthcare Professionals	Unspecified	Moments 1-5	7133	61.4	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	18	
Wetzker et al., 2016 (40) Obser	oservational	Germany	Europe & Central High income Asia	Not covert	Pooled	Surgical ICU, Medical ICU, Neonatal ICU	Physicians, Nurses	Unspecified	Moments 1-5	32935	73.9	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	15	
					Subgroup - ICUs	Surgical ICU	Physicians, Nurses	Unspecified	Moments 1-5	6184	76.5	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified		
					Suberoup - ICUs	Medical ICU	Physicians. Nurses	Unspecified	Moments 1-5	2841	76.8	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified		
					Subgroup - ICUs	Neonatal ICU	Physicians, Nurses	Unspecified	Moments 1-5	1921	83.3	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified		
Nu et al., 2018 (101) Obse	oservation	Taiwan	East Asia & Pacific High income	Both	Covert	ICU	Unspecified	Unspecified	Moments 1-5			69.2 Unspecified	21										
					Overt	ICU	Unspecified	Unspecified	Moments 1-5		880	80.6 Unspecified											