

How do you count intensive care beds?

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Abstract

Changing environments raises new needs for statistics. Because of the pandemic, there is a huge interest in society for information concerning intensive care capacity in hospitals. In 2020, Eurostat for the first time asked the European countries to report the number of intensive care beds.

In Norway, there was no existing official statistics on intensive care beds. Statistics Norway had to respond to the new requirements and consider the possibilities to create official statistics on intensive care capacity.

Co-workers from the health statistics division teamed up with a co-worker from the division for methods. Together we raised several questions: Could we include questions on intensive care in the existing form we already send to the hospitals annually? If so, is it possible for the respondents to report the numbers according to Eurostat's definition?

The easiest option would have been to simply translate Eurostat's requirements into questions, send directly to the hospitals and create statistics based on the data we collected. However, we didn't know whether the required information was easily available for the respondents or not. Instead, we arranged online meetings with the hospitals to discuss the challenges and possibilities of reporting numbers of intensive care beds.

Collecting the data according to Eurostat's definition turned out to be challenging. In this article we share our experiences and highlight the importance of discussing with respondents before starting a new data collection. Only by communicating with the respondents we can find out which data we might collect, how to ensure that we get the data we think we get, and how to minimize the response burden.

Keywords: complexities in data collection, respondents, intensive care

1. Introduction

Changing environments raises new needs for statistics, and the Covid-19 pandemic is no exception. When we realised that we were facing a worldwide pandemic in early 2020, there was suddenly a huge interest in society for information concerning hospital capacity. Especially, the number of intensive care beds and medical ventilators were crucial. When Norway got locked down at March 12th, limited hospital capacity was used as an argument for the necessity of the radical measures.

1.1 How many intensive care beds do we have?

In 2020 there was no official statistics on the number of intensive care beds in Norway. However, in the days before lockdown, the Norwegian health authorities asked the hospitals about the number of intensive care beds. On March 13th the Norwegian Directorate of Health published the results of the survey on their web pages. The web page is no longer available.

The hospitals reported that about 250 intensive care beds were in operation. In addition, there were 550 intermediate care beds, which is something in between ordinary hospital beds and intensive care beds. According to the health authorities, in the largest hospitals, some of the intermediate care beds are so advanced that they could be used as intensive care beds. In special situations, all intermediate care beds could be upgraded to intensive care beds. In extreme cases, with more than 800 patients in need of intensive care at the same time, the hospitals could also use other areas, like emergency wards and operating theatres. In such cases, the maximum number of intensive care beds could reach 1400. However, increasing the intensive care capacity to maximum involves radical measures which will reduce the hospitals' ordinary capacity for other patient groups, including emergency care.

1.2 Joint questionnaire pilot collection

Also, there was huge cross-country interest in the number of intensive care beds. In 2021, Eurostat, WHO and OECD asked their member countries for the number of intensive care beds and occupancy rates in a pilot collection as a part of the annual “Joint questionnaire of non-monetary health care data” (Eurostat et al., 2021). From now on referred to as “the questionnaire”.

Statistics Norway is responsible for reporting Norwegian data to the questionnaire. As statisticians in Statistics Norway we had to answer the question: Could we deliver data on intensive care beds?










With no official statistics on intensive care, we initially turned to the Health Directorate’s survey. However, the survey came up with several numbers on the intensive care capacity; 250, 800 and 1400. Which one of them should we report to the questionnaire?

The questionnaire included a quite detailed definition that could help clarify which numbers we should report:

An intensive care unit (ICU) is an organized system for the provision of care to critically ill patients that provides intensive and specialized medical and nursing care, an enhanced capacity for monitoring, and multiple modalities of physiologic organ support to sustain life during a period of acute organ system insufficiency. Although an ICU is based in a defined geographic area of a hospital, its activities often extend beyond the walls of the physical space to include the emergency department, hospital ward, and follow-up clinic.

The definition of intensive care units in the questionnaire is supplemented with a matrix classifying the intensive care units into three levels. The matrix is quite complex, so we have tried to describe it by a simplified illustration in figure 1. The complete matrix identical to the one in the questionnaire is reproduced in appendix 1. The higher the level, the more advanced units. Level 3 units have, for example, more staff, physicians and nurses with formal ICU training and more complex equipment than units at lower levels. The illustration is not an exact description of the levels and must not be taken literally. It is only an attempt to illustrate level of complexity.

Figure 1: A simplification of the matrix in the questionnaire that classify the intensive care units.

	Equipment	Staff	Complexity
Level 3	 +++	 +++	 +++
Level 2	 ++	 ++	 ++
Level 1	 +	 +	 +

In total, the questionnaire asked for six variables related to intensive care beds and their usage. The following is reproduced from the questionnaire, and show the variables we were asked to report:

a) *Total adult ICU beds* (providing intensive care of Levels 1 to 3): average number of available beds* and maximum number of available beds.

b) *Critical care adult beds* (providing intensive care of Levels 2 and 3): average number of available beds* and maximum number of available beds.

c) *Total neonatal ICU beds*: average number of available beds*.

d) *Total paediatric ICU beds*: average number of available beds*.

e) *Total adult ICU occupancy rate*: average occupancy rate calculated as the number of ICU beds effectively occupied (bed-days) for intensive care divided by the number of ICU beds available (at any one time) multiplied by 365 days, with the ratio multiplied by 100. The maximum daily occupancy rate reached during the period is also requested.

f) *Days with total adult ICU occupancy rate over 80% and over 95%*: number of days over the year where the ICU occupancy rate was higher than 80% and 95%.

**Note*: Please use the average number of available beds over the year where possible. If not available, please report the number of available beds at a fixed date (e.g. 31/12).

Several of the required variables were not available in Norway at the time. In addition, we did not know how the number of beds from the Health Directorate survey fit with the questionnaire's definitions. We had to find out whether we could report any numbers at all to the questionnaire and consider the possibilities to create official statistics on intensive care.

2. How do you count intensive care beds?

To figure out if Statistics Norway could report numbers on intensive care to the questionnaire, either in short or long run, statisticians from the health statistics division teamed up with a researcher from the division for statistical methods. Together we discussed several questions. May we collect the data ourselves? Maybe we can include the questions in the existing form we already send to the hospitals annually? Is it possible for the hospitals to report the numbers according to the definitions?

The easiest option would have been to simply translate the questionnaire's requirements into questions, add them to the existing form, and send directly to the hospitals and create new official statistics based on the data we had collected. However, we did not know whether the required information was easily available for the respondents. In addition, the matrix that classify the intensive care beds is so detailed that it is not feasible to just paste it into the form and ask the respondents to fill it in. As statisticians with experience in collecting data, we knew that sending out very detailed forms is not a good idea in general. If a question needs a comprehensive guideline, the most important information might disappear among all the details. This might in turn affect the validity of the answers.

To find out whether we could collect data on intensive care and how, we needed advice from people who knew more about intensive care than us.

2.1 Discussing with the experts

We began by contacting the Norwegian Pandemic Register (NiPAR), which already had collected data on patients at intensive care units. Next, we contacted the Regional Health Authorities (RHA), who own and govern the hospitals. Both could probably give us useful advice. Finally, we wanted to make a draft of a form including

questions on intensive care beds and present it to the respondents – those who fill in the form at the hospitals.

NiPAR shared some useful insights with us. They were positive to the classification of the intensive care beds proposed in the questionnaire. They said that the criteria are recognisable in a Norwegian context, but they might be comprehensive. According to NiPAR, most Norwegian intensive care units are level 2, but some of the units at university hospitals are at level 3. Most Norwegian intermediate and post-operative units are probably level 1.

The RHA's already had some experience from collecting numbers on intensive care beds. They collected these numbers from their hospitals and reported them in the Health Directorate's survey. The RHA's told us about challenges linked to different definitions. According to the RHA's some of the local hospitals had reported too many intensive care beds in the survey. An example is a small clinic that has some beds with special equipment that could be used to keep patients alive while waiting for the air ambulance for transport to a larger hospital with intensive care units. The patients are indeed intensive care patients, but the clinic does not have enough trained personnel to consider these beds as intensive care beds.

With new insights from the dialogs, we started to sketch a form to collect the data demanded by the questionnaire.

2.2 Creating the form based on our new insights

We decided to add the questions on intensive care in the existing form we send to the hospitals annually. We did our best to translate the questionnaire's questions into Norwegian language and context, with the advice from NiPAR and the RHAs in mind.

We created the sketch shown in figure 2. Now, we were ready to show it to the respondents and discuss the challenges and possibilities of reporting the numbers.

Figure 2: Sketch of the form we presented to the respondents.

Spørsmål 4: Hvor mange av sengene og -døgnene oppgitt i spørsmål 1 og 2 var...?			
Vær oppmerksom på at listen over typer senger ikke er uttømmende. Antall oppgitte senger her vil ikke være like høyt som i spørsmål 1 og 2.			
	Antall senger per andre onsdag i november 2020	Antall sengedøgn i 2020	
Postoperative senger og intermedieersenger	<input type="text"/>	<input type="text"/>	
Intensivsenger for voksne med maks tre pasienter per sykepleier	<input type="text"/>	<input type="text"/>	
Øvrige intensivsenger for voksne	<input type="text"/>	<input type="text"/>	
Intensivsenger for nyfødte	<input type="text"/>	<input type="text"/>	
Intensivsenger for barn, ekskl. nyfødte	<input type="text"/>	<input type="text"/>	
Senger ved rehabiliteringsavdelinger	<input type="text"/>	<input type="text"/>	
Spørsmål 5: Hva var gjennomsnittlig og maksimalt belegg for...?			
	Gjennomsnittlig beleggsprosent i 2020	Maksimal beleggsprosent i 2020	
Postoperative senger og intermedieersenger	<input type="text"/> %	<input type="text"/> %	
Intensivsenger for voksne med maks tre pasienter per sykepleier	<input type="text"/> %	<input type="text"/> %	
Øvrige intensivsenger for voksne	<input type="text"/> %	<input type="text"/> %	
Spørsmål 6: Hvor mange dager i 2020 var det over 80 og 95 prosent belegg for...?			
	Over 80 prosent	Over 95 prosent	
Postoperative senger og intermedieersenger	<input type="text"/>	<input type="text"/>	dager
Intensivsenger for voksne med maks tre pasienter per sykepleier	<input type="text"/>	<input type="text"/>	dager
Øvrige intensivsenger for voksne	<input type="text"/>	<input type="text"/>	dager

3. Discussing with the respondents

We invited some of the persons that had previously filled in the existing form, to a digital meeting. We wanted representatives from both small and large hospitals and from different regions. It turned out that the hospitals were quite busy at that moment, as we were in the middle of a pandemic. Fortunately, we managed to convince three hospitals to participate; two university hospitals and a smaller hospital with several locations.

In March 2021, the three of us from Statistics Norway were sitting at our home offices in front of our computers ready for the online meeting with the respondents. It was the researcher from the division for statistical methods that was going to be the moderator who lead the discussion. He has extensive experience with interviewing respondents about filling in forms from Statistics Norway. In addition, he has not created the form and has not detailed knowledge about neither the hospital sector nor intensive care units.

A purpose of the interview was to reveal possible misunderstandings. The statisticians who has made the form might be tempted to explain to the respondents if they misunderstood something. The two of us from the division for health statistics were supposed to only observe the discussion and take notes. We were muted and had switched our cameras off, to ensure that we did not interrupt the interview.

3.1 “Impossible”

All three respondents had filled in the existing form to Statistics Norway several times, and they would be the ones to fill in the revised form if we decided to include questions on intensive care beds as well.

According to all three respondents, numbers of intensive care beds in general are quite easy to report. “It’s 289 intensive care beds in Norway” one of them said. Counting post-operative and intermediate beds was also manageable.

When asked about reporting on numbers of intensive care beds with at least one nurse per three patients, all three responded “Impossible!” in choir. The patient to nurse-ratio varies too much over the day.

Asking for beds with at least one nurse per three patients was an attempt by us statisticians to simplify the matrix. In order to report according to the questionnaire’s requirements, we should distinguish between level 1 and level 2 beds. As we think the matrix is too comprehensive, we chose one of the criteria that we believed was clear and probably manageable to respond in accordance with.

When we wrote that question, we sat in our offices and made questions that we believed were easy to answer. When speaking with the respondents, it turned out that the question was in fact impossible to answer.

3.2 Neither of the categories fits with reality!

In the sketched form, we asked for intensive care beds for adults, for children and new-borns separately in order to fulfil the international requirements. When asked how they would fill in the numbers, the respondents were unsure. The beds for new-borns was easy to report but distinguishing between children's beds and beds for adults was more difficult. Most hospitals in Norway don't have separate intensive care units for children, but general intensive care units. Most patients are adults, but younger intensive care patients do also get treatment in the same beds.

How should the respondents fill in the number of beds? Should they report all beds as adult beds as most patients are adults, and no beds for children because they don't have separate child units? Or should they estimate how many of the beds that are used by children in average? As statisticians we had not thought about these questions in advance. We realised that we had to reformulate our questions. Otherwise we risked that the respondents would interpret them differently and thereby give answers with low validity.

3.3 Response burden

The moderator then turned to the questions on occupancy rate. According to the respondents, counting maximum occupancy rate during a year and number of days with occupancy rate above certain levels would require more frequent registrations at the hospitals. They who had to do more registrations would be those who work at the intensive care units, namely the intensive care nurses. As the respondents said; "They have already more than enough to do!".

As the respondents expressed that the response burden was too high, we should listen to them. As co-workers in Statistics Norway we should think about what's in society's interest. It's probably not a good idea that intensive care nurses should make daily registrations where the only purpose was reporting numbers to Statistics Norway.

3.4 *New ideas*

Towards the end of the interview, the moderator asked the respondents whether the data we ask for are easily available to them. It turned out that filling in the form could be a quite manual job. The respondent working at the hospital with several locations had to call the various locations to collect the numbers herself in advance of filling in the form. The other two respondents could just log in at the hospital's administrative systems to find the total number of beds.

However, reporting numbers of intensive care beds would be a manual job for all three respondents. The administrative systems at the three hospitals show the total number of beds, but not which of them that are intensive care beds. "It would have been much easier if the administrative systems showed which beds that are intensive care beds" one of the respondents said.

As statisticians in Statistics Norway, we know little about how much time the respondents spend filling in our forms, unless we ask them. Neither do we know for sure how we can make it easier to report numbers to us. We might have some ideas about which numbers are difficult to fill in, and how to make it easier for the respondents, but only the respondents *know* for sure. As in this case, the respondents even might come up with some ideas we wouldn't have thought of on our own. If the hospitals are going to report numbers on intensive care beds on a regular basis it would probably be a good idea to adjust the hospital's administrative systems.

4. What did we learn?

When the digital meeting ended and the respondents logged off, the three of us from Statistics Norway gathered to summarise. All three of us were of the same opinion: We could not just send out the form we had initially sketched. The questions had to be revised in order to collect data of good quality, which the respondents are able to report.

From the interviews we got some useful insights. By talking with the respondents, we might...

1. work out what numbers the respondents are capable to report, and which they cannot.
2. ... be able to adapt the questions and categories to better fit respondents' context.
3. ... find out how large the response burden is.
4. ... come up with new ideas we wouldn't have thought about ourselves.

This is how we will summarise our experiences from discussing possibilities of reporting intensive care beds with representatives from hospitals in Norway. However, we believe that our experiences should be relevant when creating forms on other subjects and in other countries.

5. What now?

Norway have still not reported any numbers on intensive care beds to the questionnaire. When talking with the RHAs, NiPAR and representatives from hospitals we found that the definition on intensive care beds which is common in Norwegian hospitals does not fit with the international definition. The 289 Norwegian intensive care beds that one of the respondents mentioned should probably be multiplied in order to be comparable internationally. By now, we don't know by how much.

As statisticians, we are somewhere in the middle between the respondents and international statistics. On the one hand, we should use the terms that are common to the respondents when sending them forms to fill in. On the other hand, when reporting data internationally, we must ensure that the data corresponds to international terms. The same term might have a somewhat different meaning in various countries.

However, we do not think that creating official statistics on intensive care capacity and reporting them via the questionnaire is impossible. But we think it will require a

broader collaboration between health authorities, hospitals, NiPAR, the providers of the hospital's administrative systems and Statistics Norway. It remains to look further into the Norwegian and international definitions, and to figure out whether it's possible to collect the data at an expectable response burden for the respondents.

6. One year later

In late April 2022 the Norwegian "Coronavirus Commission" delivered their second evaluation report. Among the main conclusions is the unknown intensive care capacity in Norway. They suggest this could be explained by professional disagreements. An interregional working group had worked on establishing a common definition on intensive care beds in Norway since 2018, but the work was not completed when the commission report was published. However, only one month later, the working group came up with a recommendation for a definition. The definition divides hospital beds into four levels, of which "intensive care beds" are at the highest level. With a clear definition (hopefully), the RHAs will now start to count the number of beds at each level in their region.

For Statistics Norway, it remains to find out how well the recommended Norwegian definitions fit with the definitions in the questionnaire. We hope that the work done by the working group will make it easier to collect Norwegian data on intensive care capacity and report the numbers according to the questionnaire's definitions.

7. References

Eurostat, OECD, WHO-Europe. (2021). *Joint Data Collection on Non-Monetary Health Care Statistics, Guidelines for completing the OECD, Eurostat/WHO-Europe Questionnaire 2021 (JQNMHC 2021)*.

Regionale helseforetak. (2022). *Rapport fra interregional arbeidsgruppe for intensivkapasitet*. https://helse-sorost.no/Documents/Om%20oss/Hva%20gj%c3%b8r%20vi/Utredning%20av%20fremtidig%20behov%20for%20intensivkapasitet%20i%20spesialisthelsetjenesten/rapport-interregional-arbeidsgruppe-intensivkapasitet_endelig_06_05_22.pdf

8. Appendix

Appendix 1: From the “Joint questionnaire on non-monetary health care statistics – 2021”. Definitions, sources and methods. Pilot data collection. Norway. Classification of ICUs

	Level 1	Level 2	Level 3
Therapeutic capacity	Physiologic stabilization and short-term support of mild organ dysfunction	Basic support of failing organ function	Complex, comprehensive support and management of organ dysfunction
Personnel	Physicians with some experience in critical care available at least during the day	Physicians with ICU training or comparable experience present during day and available at night	Physicians with formal ICU training on call 24/7; immediate in-hospital availability of medical staff with ICU experience
	Experienced nurses provide 24/7 care	Nurses have extra training or comparable experience in critical care and provide 24/7 care	Nursing staff with specialist ICU training provide 24/7 care
	Other personnel available	Variable inclusion of allied health personnel—respiratory therapists, physiotherapists,	Allied health personnel—respiratory therapists, physiotherapists, pharmacists, dieticians, etc.—

	Level 1	Level 2	Level 3
		dieticians, pharmacists, etc.—as part of ICU care team	as regular members of ICU team
	Nurse-patient ratio higher than on ward; preferably 1:4 or 1:3 (1 nurse for 4 patients)	Nurse-patient ratio appropriate to patient needs but usually no less than 1:3	Nurse-patient ratio appropriate to patient needs and no less than 1:2
	Daily rounds; ad hoc structure	Formal daily ICU rounds with physicians and nurses	Formal multidisciplinary ICU rounds daily and as needed based on patient complexity and acuity
	Variable engagement in critical care continuing professional education	Engagement in continuing professional education	Regular engagement in continuing medical/nursing education
	Variable access to other medical specialties in hospital	Ready access to respirologists, nephrologists, cardiologists, infectious disease specialists, general surgeons	Rapid access to and variable engagement of full complement of medical and surgical consultant specialists
Monitoring capacity	Non-invasive or minimally invasive monitoring—transcutaneous oxygen saturation, cardiac monitoring, urine output	Invasive monitoring of blood pressure and central venous pressures as dictated by patient status	Advanced hemodynamic monitoring (cardiac catheterization, ultrasonography, etc.); advanced monitoring of pulmonary, cerebral, and other physiology as directed by clinical needs
		Blood gas analyser immediately available	Blood gas analyser and stat lab associated with ICU
Unit design and organ support	Dedicated geographic area	Dedicated geographic area with central monitoring station	Dedicated geographic area with individual patient care areas and central monitoring station
	Capacity for oxygen therapy and non-invasive respiratory support	Basic mechanical ventilatory support, pharmacologic support of cardiovascular	Advanced ventilator and hemodynamic support, continuous renal replacement therapy,

	Level 1	Level 2	Level 3
		function, intermittent renal replacement therapy, parenteral nutrition	capacity for tracheostomy and other basic surgical procedures
			Capacity for isolation of patients needing contact or airborne precautions
Integration within the hospital	Defined geographic area only	Ad hoc interactions with other acute care areas such as emergency department	Outreach team(s), integration with step-down or high-dependency unit; close collaboration with emergency department
Research and education	Ad hoc activity	Organized educational activities for staff	Formal educational programs for staff
	Basic quality improvement program	Formal quality improvement program	Formal quality improvement program
		Ad hoc engagement in clinical research	Active involvement in clinical research
			Training of residents and fellows as available
Responsiveness to regional and societal needs	Ad hoc only, but available and responsive in event of disaster	Serves as resource for critically ill patients within hospital	Referral resource for community and district hospitals and for other ICUs
	Formal policy outlining criteria for patient transfer to higher level ICU		Disaster preparedness plan and capacity

Source: Marshall et al. (2017), What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine, Journal of Critical Care.