

Noise pollution in the ICU

Citation for published version (APA):

Simons, K. S., Park, M., Kohlrausch, A., van den Boogaard, M., Pickkers, P., de Bruijn, W., & de Jager, C. P. C. (2014). Noise pollution in the ICU: time to look into the mirror. *Critical Care*, 18(4), Article 493.
<https://doi.org/10.1186/s13054-014-0493-1>

DOI:

[10.1186/s13054-014-0493-1](https://doi.org/10.1186/s13054-014-0493-1)

Document status and date:

Published: 27/08/2014

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

LETTER

Noise pollution in the ICU: time to look into the mirror

Koen S Simons^{1,2*}, Munhum Park³, Armin Kohlrausch³, Mark van den Boogaard², Peter Pickkers², Werner de Bruijn³ and Cornelis PC de Jager¹

See related research by Darbyshire and Young, <http://ccforum.com/content/17/5/R187>

We read with interest the recent issue of *Critical Care* in which Darbyshire and Young [1] reported on noise levels in five different ICUs and demonstrated average sound pressure levels far above the World Health Organization recommended standard of 35 dB L_{Aeq} (A-weighted energy-equivalent sound pressure level in decibels). Although their article provides an interesting insight into the ICU soundscape, the authors did not attempt to investigate the sources of noise. In the literature, only few studies have performed an analysis of noise sources, using either questionnaires [2] or a human observer in the patient's room [3-5]. Aiming to provide more insight into this matter, some of the authors recently performed an acoustic survey in an ICU room in order to determine which sources are responsible for the high noise levels, and details of this study were recently published [6]. Briefly, an audio recording was made by using a calibrated microphone in an ICU room at Jeroen Bosch Hospital for a duration of 67 hours. In addition to the analysis of various acoustic parameters, a 24-hour audio fragment was manually annotated by six research assistants. All sound events ($n = 27,421$) were identified by using 28 noise source labels, which were grouped into five noise categories.

Acoustic analysis showed an average sound pressure level of 61 dB L_{Aeq} when the room was occupied. In agreement with the aforementioned study, the number of predicted loudness peaks was up to 90 per hour. Restorative periods were defined as periods of at least 5 minutes in which the sound pressure level relative to the background level did not exceed 17.7

dBa (A-weighted sound pressure level in decibels); only approximately 46% of the periods recorded at night were considered to be restorative, and the average duration of these restorative periods was approximately 13 minutes. Source-specific analysis revealed that, on average, noisy events related to staff activities (54 dB L_{Aeq}) occurred approximately 10 times per minute, staff speech (55 dB L_{Aeq}) occurred approximately 4 times per minute, and alarms (57 dB L_{Aeq}) also occurred approximately 4 times per minute. Further analyses showed that 57% of total acoustic energy and 92% of predicted loudness peaks could be attributed to the activities and speech of hospital personnel (Figure 1). We agree with Darbyshire and Young [1] that high sound pressure levels may have detrimental effects in the already vulnerable population of ICU patients. The aforementioned study demonstrates that more than half of all acoustic energy in an ICU is related to human activities and speech and therefore is potentially modifiable. Strategies involving the adaptation of human behavior therefore may prove to be very effective at reducing noise pollution in the ICU.

Abbreviation

dB L_{Aeq} : A-weighted energy-equivalent sound pressure level in decibels.

Competing interests

MP, AK, and WdB are employees of Koninklijke Philips n.v. (Amsterdam, The Netherlands), which provided the recording equipment used in the study described above. KSS, MvdB, PP, and CPCdJ declare that they have no competing interests.

Author details

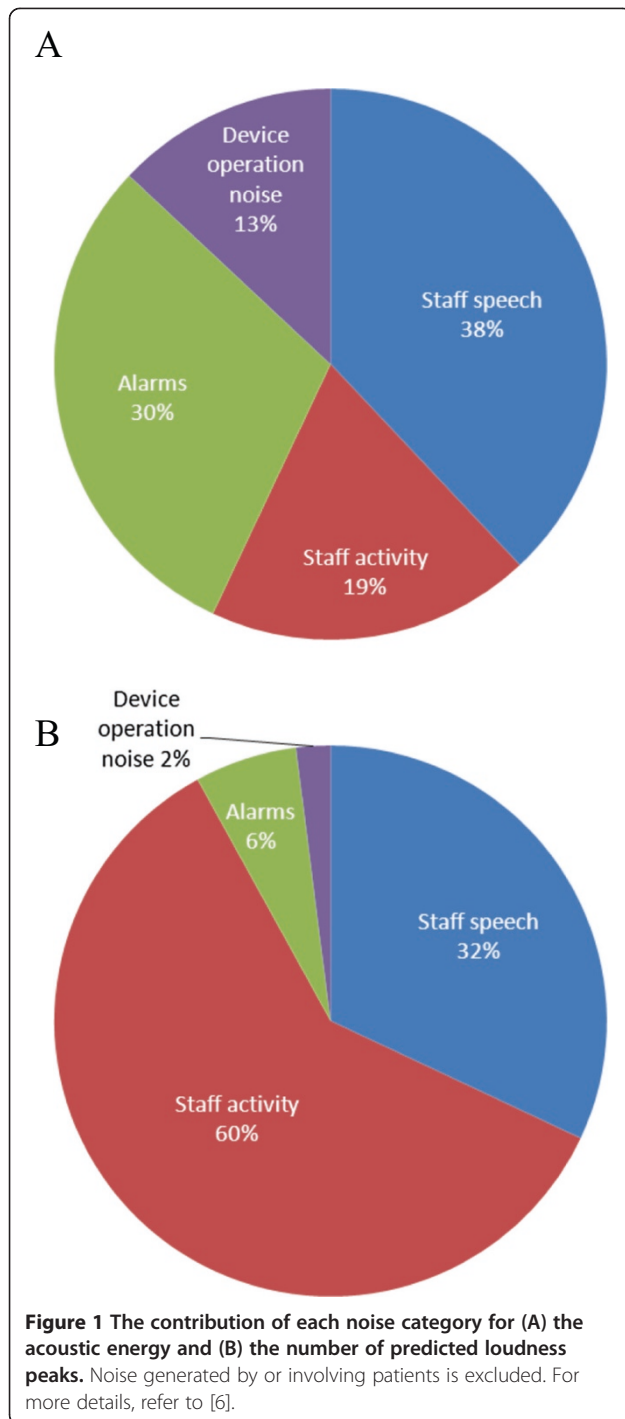
¹Department of Intensive Care and Emergency Medicine, Jeroen Bosch Ziekenhuis, Henri Dunantstraat 1, 's Hertogenbosch 500 ME, The Netherlands. ²Department of Intensive Care Medicine, Radboud University Medical Centre, Geert Grooteplein 21, Nijmegen 6500 HB, The Netherlands. ³Smart Sensing & Analysis Group, Philips Research Laboratories, High Tech Campus 36, Eindhoven 5656 AE, The Netherlands.

* Correspondence: k.simons@jzbz.nl

¹Department of Intensive Care and Emergency Medicine, Jeroen Bosch Ziekenhuis, Henri Dunantstraat 1, 's Hertogenbosch 500 ME, The Netherlands

²Department of Intensive Care Medicine, Radboud University Medical Centre, Geert Grooteplein 21, Nijmegen 6500 HB, The Netherlands

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



3. Tegnestedt C, Gunther A, Reichard A, Bjurstrom R, Alvarsson J, Martling CR, Sackey P: Levels and sources of sound in the intensive care unit - an observational study of three room types. *Acta Anaesthesiol Scand* 2013, **57**:1041–1050.
4. Hilton BA: Noise in acute patient care areas. *Res Nurs Health* 1985, **8**:283–291.
5. Tsiou C, Eftymiatis D, Theodossopoulou E, Notis P, Kiriakou K: Noise sources and levels in the Evgenidion Hospital intensive care unit. *Intensive Care Med* 1998, **24**:845–847.
6. Park M, Kohlrausch A, de Bruijn W, de Jager C, Simons K: Analysis of the soundscape in an intensive care unit based on the annotation of an audio recording. *J Acoust Soc Am* 2014, **135**:1875–1886.

doi:10.1186/s13054-014-0493-1

Cite this article as: Simons et al.: Noise pollution in the ICU: time to look into the mirror. *Critical Care* 2014 **18**:493.

Published online: 27 August 2014

References

1. Darbyshire JL, Young JD: An investigation of sound levels on intensive care units with reference to the WHO guidelines. *Crit Care* 2013, **17**:R187.
2. Ugras GA, Oztekin SD: Patient perception of environmental and nursing factors contributing to sleep disturbances in a neurosurgical intensive care unit. *Tohoku J Exp Med* 2007, **212**:299–308.