REFERENCES

1. Gustafson OD, Rowland MJ, Watkinson PJ, et al: Shoulder Impairment Following Critical Illness: A Prospective Cohort Study. *Crit Care Med* 2018; 46:1769–1774
2. Williams RJ, Tse T, Harlan WR, et al: Registration of observational studies: Is it time? *CMAJ* 2010; 182:1638–1642
3. Struyf F, Geraets J, Noten S, et al: A multivariable prediction model for the chronification of non-traumatic shoulder pain: A systematic review. *Pain Physician* 2016; 19:1–10
4. Page MJ, Green S, Kramer S, et al: Electrotherapy modalities for adhesive capsulitis (frozen shoulder). *Cochrane Database Syst Rev* 2014; (10):CD011324
5. Babyak MA: What you see may not be what you get: A brief, nontechnical introduction to overfitting in regression-type models. *Psychosom Med* 2004; 66:411–421

DOI: 10.1097/CCM.0000000000003510

The authors reply:

We read with interest the letter to the editor by Ariie (1) regarding our recent publication in *Critical Care Medicine*, in which we identified a high prevalence of shoulder impairment following critical illness. We did not register the protocol before commencing recruitment as this was a single center observational cohort study. There is a risk of bias in any study of this kind, which we have acknowledged in our discussion. However, the primary objectives and outcome measures are clearly defined in the article along with full details of the sequential patient screening as outlined in the study flow diagram.

Patients underwent routine intensive and inpatient care for the United Kingdom, with rehabilitation aimed predominantly at reablement and discharge home from hospital. This may have included upper limb rehabilitation but is highly unlikely to have included specific interventions for shoulder impairment as this is not routinely delivered in the U.K. inpatient setting. Following hospital discharge, none of the patients assessed had attended physiotherapy for shoulder impairment prior to our assessment, which is consistent with the limited rehabilitation provision for ICU survivors following discharge from hospital (3).

We selected variables for inclusion in our multivariate analysis based on their statistical significance in univariate analysis. This method is often employed in association studies and has a number of practical advantages (4). As there were no independently associated variables in our results, there is no overfitting. Selecting variables identified through univariate analysis at traditional significance levels ($p < 0.05$) may result in potentially important variables being overlooked (5). Setting a higher significance level reduces this risk (6), and we believe our results would not meaningfully differ using alternative variable selection methods. The demographic information for nonattenders could have been presented; however, as no risk factors were identified, we feel this would not have enlightened the reader further.

Dr. Watkinson's institution received funding from the National Institute for Health Research, and he received funding from Sensyne Health. The remaining authors have disclosed that they do not have any potential conflicts of interest.

Owen D. Gustafson, MSc Res, Matthew J. Rowland, PhD, Peter J. Watkinson, MD, Stuart McKechnie, PhD, Kadoorie Centre for Critical Care Research, Nuffield Department of Clinical Neurosciences, University of Oxford, John Radcliffe Hospital, Oxford, United Kingdom, and Adult Intensive Care Unit, Oxford University Hospitals NHS Foundation Trust, Oxford, United Kingdom; **Simon Igo, PhD,** Department of Health and Life Science, Coventry University, Coventry, United Kingdom

REFERENCES

1. Ariie T: Risks of Misunderstanding Results. *Crit Care Med* 2019; 47:e160–e161
2. Gustafson OD, Rowland MJ, Watkinson PJ, et al: Shoulder impairment following critical illness: A prospective cohort study. *Crit Care Med* 2018; 46:1769–1774
3. Connolly B, Salisbury L, O'Neill B, et al: Exercise rehabilitation following intensive care unit discharge for recovery from critical illness. *Cochrane Database of Syst Rev* 2015; (6):CD008632
4. Steyerberg EW: Clinical Prediction Models: A Practical Approach to Development, Validation, and Updating. New York, Springer Science and Business Media, 2009, pp 206–207
5. Bursac Z, Gauss CH, Williams DK, et al: Purposeful selection of variables in logistic regression. *Source Code Biol Med* 2008; 3:17
6. Mickey RM, Greenland S: The impact of confounder selection criteria on effect estimation. *Am J Epidemiol* 1989; 129:125–137

DOI: 10.1097/CCM.0000000000003568

Pressure Injury Research in the ICU: Getting Rid of a Black Spot

To the Editor:

We thank Chaboyer et al (1), recently published in *Critical Care Medicine*, for increasing the visibility of the problem of pressure injuries (PIs) in the ICU through their solidly conducted systematic review and meta-analysis.

ICU patients are preeminently susceptible to developing PI through complexly interacting intrinsic and extrinsic risk factors (2). Furthermore, continuously enhancing insights and technology have led to an increasing pool of long-term, older, more deconditioned patients (3). Hence, PI prevention imposes considerable challenges on their caregivers.

Research on PI has seldomly been prioritized by critical care investigators and has mainly focused on other high-risk populations, mainly the impaired elderly. Additionally, the awareness that PI prevention is a concern to each team member and not a mere nursing care issue has only been increasing more recently and might have hindered the development of large-scaled research. Good quality data are therefore restricted, and to be held accountable for some limitations of the study by Chaboyer et al (1).

The publications included were found to be considerably heterogeneous. Besides the potential explanations mentioned—different measurement methods, regional variations in occurrence, prevention strategies and resources—the large variation in ICU populations in itself might have contributed to this heterogeneity.

Among this large variety of ICU patients, some groups are inherently of high risk for PI development, such as burn-injured, obese, and patients with peripheral vascular disease. By lacking specific data, the authors were unable to perform subanalyses quantifying occurrence rates among ICU high-risk groups, whereas this information could have assisted clinicians in determining the extent and nature of preventive strategies for these patients.

It was also identified that cumulative incidence studies of the general hospital population are limited, leaving a gap of knowledge in determining which PIs are present upon ICU admission and which ones are ICU-acquired. This could be of value in identifying and addressing crosscutting challenges at hospital level, and in guiding treatment and prevention strategies that potentially help alleviating the burden of PI in the ICU.

Another subanalysis of interest but not performed due to data scarcity relates to the influence of nurses' workload on PI occurrence. Low nurse-to-patient ratios are suggested to negatively affect PI development, but evidence to date remains inconclusive (4). Regrettably, the study by Chaboyer et al (1) was unable to increase insights in this issue.

Last, large differences undeniably prevail between ICU populations, staffing, resources, and care priorities between high-, middle- and low-income countries. Again due to data unavailability, the meta-analysis failed to provide any information about the relation between PI occurrence and country income classification.

Well-conducted, international studies are needed to keep up with present epidemiology of PI in ICUs (5). DecubICUs is a worldwide point-prevalence study by the European Society of Intensive Care Medicine's Trials Group, aiming to document the scope of the problem (https://www.esicm.org/research/trials/trials-group-2/decubicus/). Although data will be uploaded until end 2018, the large amount of currently inputted information indicates that the data will allow thorough epidemiologic analyses. The eventual study objective is, of course, to make a valuable contribution to optimizing patient safety and care.

Dr. Labeau disclosed that she is investigator in the DecubICUs study. The remaining authors have disclosed that they do not have any potential conflicts of interest.

Sonia O. Labeau, RN, MA, MNSc, PhD, Faculty of Medicine & Health Science, Ghent University, Belgium, and Faculty of Education, Health and Social Work, University College Ghent, Belgium; **Elsa P. Afonso, RN, MSc,** Rosie NICU, Cambridge University Hospitals, Cambridge, United Kingdom, and Faculty of Medicine & Health Science, Ghent University, Belgium; **Mireia Llaurado-Serra, RN, MSc, PhD,** Universitat Internacional de Cataluña, Barcelona, Spain, and Faculty of Medicine and Health Sciences, Spain

REFERENCES

1. Chaboyer WP, Thalib L, Harbeck EL, et al: Incidence and Prevalence of Pressure Injuries in Adult Intensive Care Patients: A Systematic Review and Meta-Analysis. *Crit Care Med* 2018; 46:e1074–e1081
2. de Almeida Medeiros AB, da Conceição Dias Fernandes MI, de Sá Tinôco JD, et al: Predictors of pressure ulcer risk in adult intensive care patients: A retrospective case-control study. *Intensive Crit Care Nurs* 2018; 45:6–10
3. Blot S, Cankurtaran M, Petrovic M, et al: Epidemiology and outcome of nosocomial bloodstream infection in elderly critically ill patients: A comparison between middle-aged, old, and very old patients. *Crit Care Med* 2009; 37:1634–1641
4. Greaves J, Goodall D, Berry A, et al: Nursing workloads and activity in critical care: A review of the evidence. *Intensive Crit Care Nurs* 2018; 48:10–20
5. Llaurado-Serra M, Afonso E: Pressure injuries in intensive care: What is new? *Intensive Crit Care Nurs* 2018; 45:3–5

DOI: 10.1097/CCM.0000000000003512

The authors reply:

We thank Labeau et al (1) for their interest and thoughtful letter about our systematic review of the incidence and prevalence of pressure injuries (PIs) in adult ICU patients (2), recently published article in *Critical Care Medicine*. We agree heterogeneity was the major threat to validity in pooling the ICU incidence and prevalence and we also agree on the potential sources of heterogeneity. As Labeau et al (1) note, it was not possible to assess most potential causes of heterogeneity in ICU PI events due to paucity of data, which we too identified. The influence of nurses' workload on PI occurrence is an inconclusive area. One study cited in a review noted that increased ICU nurse staffing in was associated with decreased PI development (3). Internationally, the intensive care environment remains a comparatively well-resourced clinical area. Although we argue adequate staffing levels are important for the prevention of PI, timely regular skin assessment and implementation of prevention strategies based on patient need also strongly influence the outcome of PI development. Because of ICU patients' disease acuity and complexity, emerging evidence to suggest multicomponent PI prevention programs, especially those with multidisciplinary involvements, are needed (4–6). We too believe PI prevention requires a multidisciplinary approach.

We had also postulated that a country's wealth, classified as low-, middle-, or high-income countries (according to Gross Domestic Product [GDP]) may serve as a proxy for the quality of overall healthcare provision. But, our quick analysis showed no clear patterns in the data by GDP, perhaps because a myriad of other factors influence the development of PI beyond simply being in a rich or poor country. Some of these confounding factors were well articulated by Labeau et al (1). We too believe PI prevention requires a multidisciplinary approach. We think the international DecubICUs study may provide valuable insights into numerous factors that influence prevalence of PI in the ICU setting. In the meantime, our team plans to continue further research synthesis studies to better understand PI in the ICU setting.

Dr. Coyer's institution received funding from 3M and Molnlycke Pty Ltd. The remaining authors have disclosed that they do not have any potential conflicts of interest.

Wendy P. Chaboyer, PhD, FACCCN, FAAN, School of Nursing and Midwifery, Menzies Health Institute