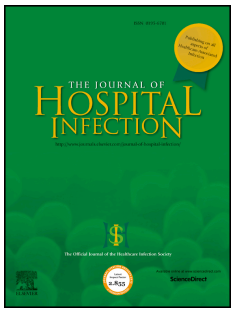
Accepted Manuscript



Revisiting the winter burden of acute gastroenteritis on hospital beds in England: change in data collection supports analytical method for previously missing values

F.G. Sandmann, M. Jit, J.V. Robotham, S.R. Deeny

PII: S0195-6701(18)30322-0

DOI: 10.1016/j.jhin.2018.06.008

Reference: YJHIN 5459

To appear in: *Journal of Hospital Infection*

Received Date: 4 June 2018

Accepted Date: 7 June 2018

Please cite this article as: Sandmann FG, Jit M, Robotham JV, Deeny SR, Revisiting the winter burden of acute gastroenteritis on hospital beds in England: change in data collection supports analytical method for previously missing values, *Journal of Hospital Infection* (2018), doi: 10.1016/j.jhin.2018.06.008.

Revisiting the winter burden of acute gastroenteritis on hospital beds in England: Change in data collection supports analytical method for previously missing values.

Target journal: JHI. "Letters should contain up to 800 words of text and no more than eight references. One table or figure is permitted.": 798 words, 3 references, 1 figure.

Authors

F.G. Sandmann[a,b], M. Jit[a,b], J.V. Robotham[a], S.R. Deeny[c]

a *Modelling and Economics Unit, Public Health England, London, UK*

b *Department of Infectious Disease Epidemiology, London School of Hygiene and Tropical Medicine, London, UK*

c *The Health Foundation, London, UK*

Corresponding author contact details

Frank Sandmann

Modelling and Economics Unit

National Infection Service

Public Health England

61 Colindale Avenue, London, NW9 5EQ, UK

Frank.Sandmann@phe.gov.uk

Conflict of interest statement

Nothing to declare.

Funding source

MJ was supported by the National Institute for Health Research (NIHR) Health Protection Research Unit in Immunisation at the London School of Hygiene and Tropical Medicine in partnership with Public Health England (Grant Reference Code HPRU-2012-10096). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR, the Department of Health, or Public Health England.

Main text ("Letters should not contain structural headings or a summary.")

Sir,

In a study published previously in this journal [1], we estimated that all-cause acute gastroenteritis resulted in a median 88,000–113,000 bed closures in hospitals in England each winter, placing a financial burden on hospitals of at least £5.7–£7.5 million (or £6.9–£10.0 million when including staff absence costs). Our analysis used routinely-collected data of the number of occupied and unoccupied hospital beds closed (i.e., unavailable to other patients) due to diarrhoea and vomiting during the winters 2010/11 to 2015/16. These data have been reported mandatorily by all acute care hospitals in England for weekdays, and the National Health Service (NHS) England has published them as part of the winter situation reports (SitReps) since 2010/11 [2].

We previously used two imputation scenarios to estimate the number of bed-days lost to acute gastroenteritis on weekends and public holidays, therefore addressing the issue of the fact one third of days were missing [1]. The imputation scenarios were based on the number of bed-days recorded as closed immediately before and after the weekends and public holidays, using the lowest and highest numbers as best-to-worst case scenarios. There are a number of limitations and assumptions underlying this approach, as discussed in the original paper [1], which led us to conclude: "With the information available, it is not possible to determine where exactly the number of beds closed lies on the range of the lowest to highest imputations; this inaccuracy is unavoidable though due to the values missing." [1].

Since winter 2016/17, however, NHS England has started collecting the SitReps data on weekends and public holidays [2]. This change in data collection thus provides us with a unique opportunity to compare the imputation scenarios with the actual number recorded. After obtaining the same data for winters 2016/17 and 2017/18 as in the previous analysis, we removed all records for weekends and public holidays in order for the data to resemble the situation in preceding winters. Then, we re-ran the imputation scenarios to obtain the best-to-worst case estimates, which we compared to the sum total of the actually recorded number of bed-days.

The results of this comparison are shown in Figure 1 (panel A). The mean of the best and worst case imputations was only 1.03% higher than the actually recorded number of bed-days in winter 2016/17 (i.e., 71,920/69,869), and only 1.02% higher in winter 2017/18 (86,462/84,412). An even closer match was obtained for the bed-days lost unoccupied (14,498/14,757 = -0.02% in winter 2016/17 vs. 15,502/16,036 = -0.03% in winter 2017/18). These results suggest that the mean value of the best-to-worst case imputation scenarios is an adequate proxy for the actual number of bed-days closed.

Furthermore, an infectious cause for the majority of these bed closures due to acute gastroenteritis – as we have speculated in the original paper [1] – has been confirmed in our follow-up study that regressed the SitReps data against enteric pathogen counts in laboratory-based surveillance, finding that norovirus explained more than 94% of the observed variation in bed-days closed due to acute gastroenteritis [3]. It seems thus justified for NHS England to label the records with "bed-days closed due to diarrhoea and vomiting/norovirus-like symptoms" [2].

The same follow-up study estimated a median total of 290,000 bed-days being unavailable (occupied and unoccupied) due to norovirus-associated gastroenteritis in acute care and community hospitals in England on an annual basis [3], with financial costs for the NHS of £107.6 million per year and economic costs of up to £297.7 million; an estimated 57,800 alternative patients could have been admitted were the beds made available to them. The findings described in this letter here suggest the actual burden of norovirus is likely higher than this estimated burden, as we based the unoccupied bed-days closed conservatively on the best-case scenario results with the lowest imputations [1].

In summary, we concluded in our previous analysis of the SitReps data: "If the data were collected daily over an identical time period, the imputation scenarios of this analysis would have been superfluous, and thus the data would allow more precise surveillance within and across years." [1]. These conclusions have become reality with regards to a daily collection, and it seems the arithmetic mean of the best-to-worst case imputation scenarios allows for an adequate comparison across those preceding years that had excluded the weekends and public holidays (see panel B in Figure 1).

References

1. Sandmann FG, Jit M, Robotham JV, Deeny SR. Burden, duration and costs of hospital bed closures due to acute gastroenteritis in England per winter, 2010/11-2015/16. *Journal of Hospital Infection*. 2017;**97**(1):79-85.
2. National Health Service (NHS) England. Winter Daily Situation Reports. Available at: http://www.england.nhs.uk/statistics/statistical-work-areas/winter-daily-sitreps/ [04/03/2018].
3. Sandmann FG, Shallcross L, Adams N, *et al*. Estimating the Hospital Burden of Norovirus-Associated Gastroenteritis in England and its Opportunity Costs for Non-Admitted Patients. *Clinical Infectious Diseases*. 2018:ciy167-ciy167.

Figure

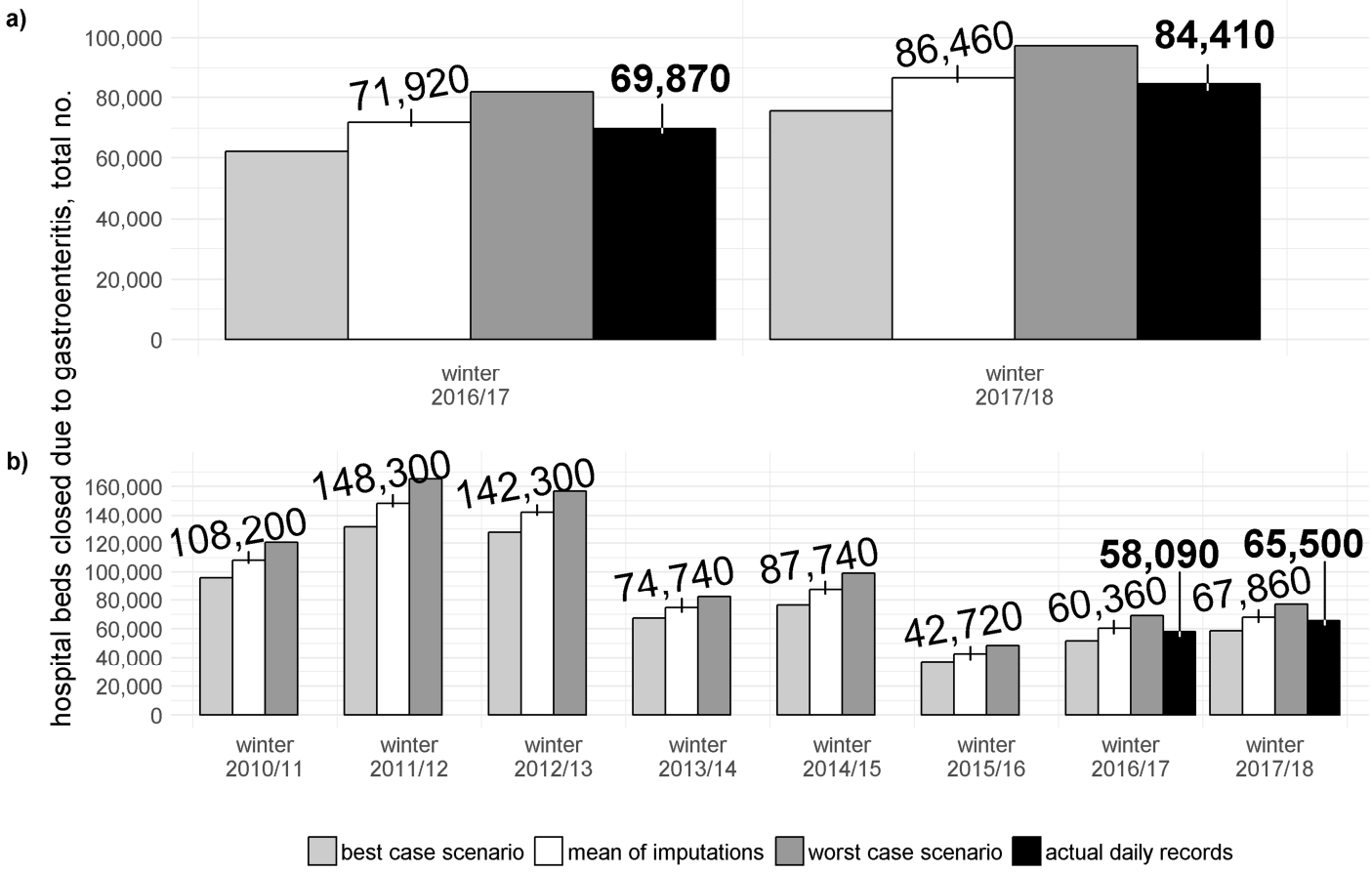


Figure 1. Total number of bed-days unavailable due to diarrhoea and vomiting in England, winters 2016/17-2017/18 (panel a) vs. winters 2010/11-2017/18 (panel b). (Note that the recording lengths differed in both winters in panel a); the values should not be compared directly with each other. For a fair comparison across winters see panel b), for which we filtered observations to a range of dates recorded in all eight winters: 1st December to 19th February.)