LETTERS TO THE EDITOR

Education-Based Intervention to Prevent Catheter-Associated Bloodstream Infection

TO THE EDITOR—In their recent article, Warren and colleagues[1] have described a multicenter, education-based intervention to prevent catheter-associated blood stream infections. We are concerned that the conclusions may not be warranted given the way the data were presented and analyzed.

The authors conceded that the preintervention-postintervention design may be limited because of other unmeasured factors that may have accounted for the changes in outcome. Use of this type of study is reasonable in circumstances in which randomization is not possible,[2] but the data presentation and analysis were not optimal in this study. Data in each time period were aggregated, which does not allow an assessment of the natural history of the outcomes, particularly in the preintervention period. For example, rates of catheter-related blood stream infections may have been decreasing anyway because of some other factor, and the intervention may have been coincidental in this decline. Analysis using segmented regression of interrupted time series, which gives an indication of whether there is a difference in the preintervention and postintervention slopes of the outcome, may have provided more information.[3] Graphic representation of the rates or proportions of each outcome per time period (for example, month or quarter) or an analysis for trend would have allowed the reader to assess the pattern of the outcome before and after the intervention. Figure 1 in the article by Warren et al.[1] presents data per time period for the postintervention period. The fact that the reduction in catheter-associated blood stream infections was not significant until later in the postintervention phase may have reflected the time it took to change healthcare workers' behavior, as suggested by the authors, but may also have reflected a natural fluctuation of rates. A similar breakdown of rates in the preintervention period may have helped to assess this. It is not clear in the Methods section whether any of the intervention went beyond the initial 3 month period or whether this was merely the time required for its full implementation.

We are also concerned about the correlation presented in Figure 2 in the article by Warren et al.[1] Was it repeated without the outliers? In addition, there seems to have been no adjustment made for other factors that may have influenced these correlations. For example, was the proportion of healthcare workers who completed the self-study module associated with the level of perceived degree of support?

We understand that studies such as these are difficult to undertake and very labor intensive, but we believe that appropriate data analysis is crucial to ensure that results are meaningful and useful to the reader.

Caroline Marshall, FRACP, PhD; Jim Black, MBBS, PhD

From the Centre for Clinical Research Excellence in Infectious Diseases, University of Melbourne, and the Victorian Infectious Diseases Service, Royal Melbourne Hospital (C.M.), and the Victorian Infectious Diseases Service, Royal Melbourne Hospital (J.B.), Melbourne, Victoria, Australia.

Address reprint requests to Caroline Marshall, PhD, Victorian Infectious Diseases Service, Royal Melbourne Hospital, Grattan St., Parkville, Victoria, 3050, Australia (caroline.marshall@mh.org.au).

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Reply to Marshall and Black

TO THE EDITOR—We appreciate the comments of Marshall and Black[1] regarding the presentation of data in our recent article. There are several reasons the data were displayed in this format. Displaying all of the individual study units' rates over time resulted in an uninterpretable figure, hence Figure 1 in the article[2] summarizes the data within the space limitations. The format highlights our observation of a lag between the beginning of the intervention and a decrease in rates. To address the concern that the infection rate may have been already decreasing in the preintervention period, and that the intervention was coincidental with that decrease, we offer here an alternative graph that shows the overall monthly rate of catheter-associated bloodstream infection for all of the units (Figure). From this graph, it can be seen that the overall catheter-associated bloodstream infection rate for the study units was not decreasing prior to the beginning of the intervention. It can also be noted that the rate appeared to be increasing slightly during the last 3 months of the post-

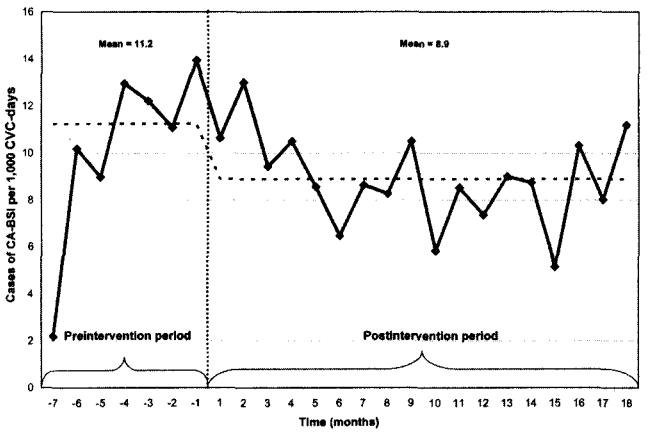

FIGURE. Overall monthly rate of catheter-associated bloodstream infection (CA-BSI) rate per 1,000 central venous catheter (CVC)-days in the intervention study.[2]

intervention period, suggesting that the benefit may decay over time and that these interventions may need to be repeated on a regular basis to compensate for staff turnover and to reinforce correct behaviors.

Marshall and Black also stated that the ideal method for analyzing the data from this study would be segmented regression of interrupted time series analysis. We agree that this is a preferable method to analyze nonindependent outcomes over time, and this method is being used increasingly in the infection control literature.[3] However, we could not use this analytical method for the following reasons. As stated in the article, we had 5-7 months of preintervention data available; only 2 of the 13 units had 7 months of data, and only 9 units had 6 months of data. Thus the initial preintervention data reflects a small portion of the total number of catheter-days and infections from a few units—and on the basis of the observed rate of infection in the seventh month prior to the intervention, we know this resulted in an unstable estimate of infection rates for that month. Therefore, we did not have a sufficient number of preintervention time points for a time-series analysis. Furthermore, if the data were grouped by smaller periods (eg, 2-week periods), there would be several time periods with 0 cases, which is problematic for time-series analysis. For the comparison of the change in the proportion of central venous catheters inserted in the femoral vein relative to the change in the catheter-associated bloodstream infection rate shown in Figure 2 of the article,[2] if unit J is removed from the analysis, there is still a significant correlation ($R^2 = 0.436$; $P = .038$). Given the small number of units in this correlation ($n = 11$), it is not feasible to adjust for covariates, as Marshall and Black[1] suggest.

Multicenter interventions to decrease the incidence of healthcare-associated infections that occur with a relatively low frequency are faced with several challenges. Designing and conducting a cluster-randomized trial comparing intervention ICUs and control ICUs, with absolute fidelity to the intervention and extensive data collection to assess the implementation of the intervention, the effect on the process of care, and the outcome of interest would be ideal. Unfortunately, such a study is logistically challenging and financially prohibitive in the current biomedical funding climate. Currently, no study in the area of catheter-related bloodstream infection prevention would fit these criteria. Until sufficient funding is available, our challenge is to continue to try to implement and evaluate measures to reduce the incidence of catheter-related bloodstream infection with the best analytical methods possible, given the limited resources.

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David K. Warren, MD, MPH; Victoria J. Fraser, MD; the Prevention Epicenter Program

From the Washington University School of Medicine, Saint Louis, Missouri (D.K.W., V.J.F)

Address reprint requests to David K. Warren, MD, MPH, Washington University School of Medicine, Campus Box 8051, 660 S. Euclid Ave., Saint Louis, MO 63110 (dwarren@im.wustl.edu).

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