Contents lists available at ScienceDirect

Diagnostic Microbiology and Infectious Disease

Relationship between bacteriology report time in the morning and length of stay in hospital after the report

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ARTICLE INFO

ABSTRACT

We studied the relationship between the time of day bacteriology reports were available in the electronic medical record (Epic, Verona, WI) and subsequent length of stay (LOS) following the last report before discharge. All patients ≥18 years admitted to the UF Health Shands Hospital between 1/1/2014–2/29/2016 were included. We calculated the mean LOS following the report for each half-hour time period between 6 AM and 1 PM (N = 14, 95.6% of all results) and tested the relationship to subsequent LOS. For patients whose total LOS was ≤168 hours (N = 13,830) there was a highly significant positive linear relationship between the report time and LOS following the last report (r = 0.8813, P = 0.00001556). For those patients with total LOS > 168 h, there was no clear relationship between report time in the morning and LOS after the last bacteriology report. The relationship between bacteriology report time in the morning and use of this information by physicians in discharge decision-making is likely to be complex and multi-factorial, but for those patients with a total hospital LOS ≤168 h, there is a strong relationship between an earlier report and earlier patient discharge.

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1. Introduction

Microbiology laboratories are under pressure to report results as rapidly as possible without sacrificing accuracy and quality. In theory, the earlier results are available to clinicians, the sooner accurate management decisions can be made and this should lead to improved outcomes. Several studies have looked at rapid microbiologic methodologies and reporting strategies, but effects on outcomes such as mortality and LOS have not been consistent. Doern et al. (1994) randomized patients to rapid (≈11 h from growth to the antibiotic susceptibility report) versus conventional bacteriology methods (≈26 h) and found significant reductions in hospital cost, and reduction in mortality from infection-related causes, but no change in overall LOS, while Barenfanger et al. (1999) using historical controls showed a significantly decreased LOS, and hospital cost, but no effect on mortality. In contrast, Bruins et al. (2005) implementing essentially the same improvements in earlier reporting and a randomized design found no change in hospital cost, mortality or LOS. Kerremans et al. (2008) studied the effect of earlier susceptibility reporting from positive blood cultures in a prospective randomized design and found an appropriate reduction in antibiotic usage, but no effect on mortality. Trenholme et al. (1989) likewise found improved antibiotic usage for patients

randomized to earlier reporting susceptibility results, and reduced antibiotic costs, but did not comment on LOS or mortality.

We retrospectively looked at the relationship between the times that bacteriology reports were available in the electronic medical record and subsequent length of stay following the last report before discharge. We included over 26,000 bacteriology reports over a 2+ year period and were able to find a strong positive relationship between report time and subsequent LOS for patients with a total hospital LOS < 168 hours.

2. Materials and methods

2.1. Study population

All adult (≥18 years) inpatients in UF Health Shands Hospital, Gainesville, Florida between 1/1/2014 and 2/29/2016 who had bacteriology cultures reported were included. We did not include patients who were still hospitalized more than 1 week (168 hours) after their last bacteriology report, on the assumption that the time of day of such a report would be unlikely to influence discharge decision. We included resistance screening cultures (VRE, MRSA), but not fungal, mycobacterial, viral, send out cultures or those done for instrument sterility. UF Health Shands Hospital is an 850 bed tertiary care academic medical center. The study was approved by the University of Florida Institutional Review Board.

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2.2. Study methods

Initially, we studied all bacteriology results between 10/1/2014–9/30/2015. Patients in the ICUs and whose overall hospital LOS was >168 h (1 week) were analyzed separately since the severity and complexity of these patients made it less likely that a single bacteriology report would influence discharge decision making. The Vizient (formerly University Health System Consortium UHC) risk-adjusted expected LOS on admission was used as a proxy for severity of illness (Anon, 1998) (https://www.uhc.edu/26295). We calculated the mean LOS following the report time for each half-hour time period between 6 AM and 1 PM (N = 14 time periods), representing 95.6% of all results, and tested the relationship to LOS after the report for significance by Pearson correlation coefficient http://www.socscistatistics.com/tests/pearson/Default2.aspx and its *P* value, http://www.danielsoper.com/statcalc/calculator.aspx?id=44.

To confirm the initial findings, we expanded the time range to 1/1/2014–2/29/2016. Since we obtained the same statistically significant results in this confirmation sample, the data for the expanded date range are presented.

2.3. Laboratory methods

Blood cultures were incubated in BacTec 9600 blood culture instruments (1/1/2014–9/1/2015) or the newer model BacTec FX (9/1/2015–2/29/2016) (Becton Dickinson and Co, Franklin Lakes, New Jersey, USA) and held for 5 days, unless signaling positive. Approximately 90% of all blood cultures have no growth and are automatically reported as No Growth after 5 days incubation. Although blood cultures are received throughout the day, in order to take advantage of the automated daily "no growth" report function, report times were functionally batched early each morning when the technologist assigned to this task arrived and as a result 90.34% of all final blood culture reports were sent between 6 and 9 AM (please see Fig. 2). This report distribution time did not change when the BacTec 9600 instruments were replaced with the BacTec FX models in September, 2015. Positive cultures from blood and all other sites were identified and tested for susceptibility by standard methods, primarily Vitek 2 but also mass spectrometry, RapidID NH System (Thermo Scientific), etc. and susceptibility testing by e-test or Kirby Bauer disk diffusion.

3. Results

There were a total of 26,429 bacteriology reports within 168 h of adult patient discharge between 1/1/2014 and 2/29/2016, reported in the electronic medical record as final between 6 AM and 1 PM. Of these, 7805 were from patients in an ICU during their hospitalization and were excluded because of their illness complexity as described in the Methods. The remaining 18,624 were divided into those whose total hospital length of stay (LOS) was ≤168 h (N = 13,830) and >168 h (4794). The ≤168 h and the >168 h groups were significantly different in several metrics: those with total hospital LOS ≤168 averaged 1.4 ± 1.2 days from the time of the last report until actual discharge, while those whose total hospital LOS was >168 h averaged 3.9 ± 1.6 days, $P < 0.0001$. Moreover, Vizient (UHC) expected LOS on admission for the group of patients with LOS ≤168 h was 5.2 ± 3.0 days versus 10.4 ± 8.4 days ($P < 0.0001$) for those with actual LOS >168 h. Actual average LOS for the ≤168 h group was 4.0 ± 1.6 days versus 13.9 ± 11.0 days ($P < 0.0001$). Expected LOS was actually negatively correlated with report time $r = -0.8705$, $P = 0.0241$ (data not shown).

For patients with total hospital LOS ≤168 h, there was a strong, positive linear relationship between the time of the last bacteriology report for all cultures and the subsequent LOS until discharge, N = 13,830, r = 0.8813, $P = 0.00001556$ (Fig. 1). This relationship was also observed for urine cultures alone N = 7994, r = 0.7989, $P = 0.00030482$, however the last report time for blood cultures (N = 2458) showed no relationship to subsequent time of discharge. As shown in Fig. 2, the distribution of report times during the day is very different for blood cultures than for all cultures and urine cultures separately. The reason for this distribution resulted from an automated system for reporting "No Growth"
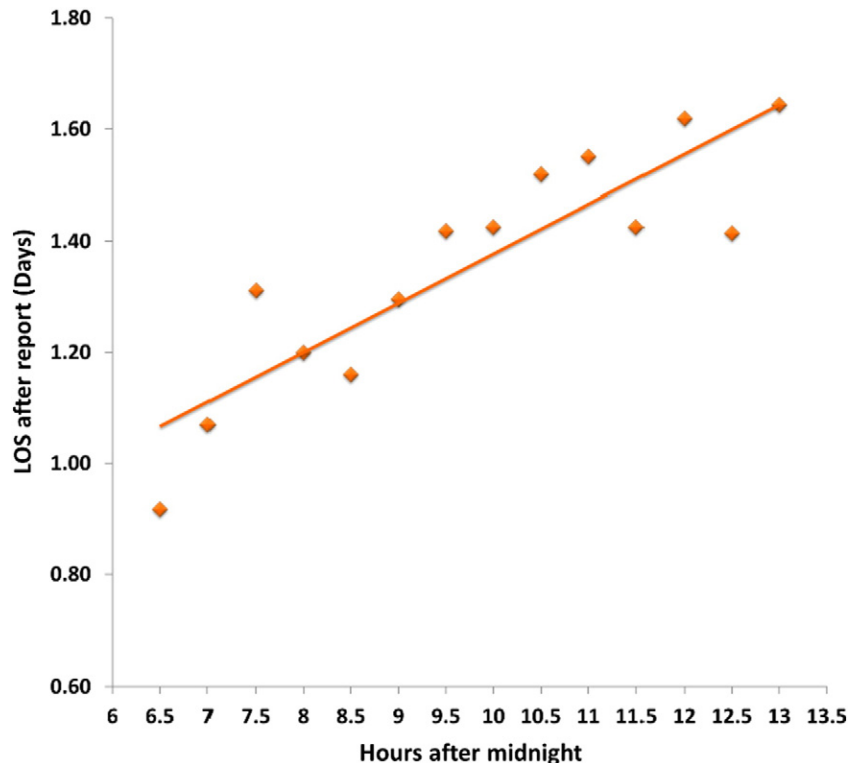

Fig. 1. Relationship between the time of day in the morning when final culture results were reported and subsequent hospital LOS until discharge for patients with total hospital LOS ≤168 h, r = 0.8813, $P = 0.00001556$.