COMMENTARY

Length of Stay and Complications Associated With Febrile Infants <90 Days of Age Hospitalized in the United States, 2000-2012: A Commentary

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Zangwill et al[1] present a statistically rigorous study designed to evaluate whether there was a change in length of stay (LOS) for young, febrile infants hospitalized for evaluation between 2000 and 2012. Using a national data set, in combination with state agencies' discharge databases, the authors of this study retrospectively analyzed LOS, risk factors for prolonged LOS, complications, and results of viral testing of >40 000 infants <90 days of age. The authors conclude that LOS for febrile infants did not change significantly during this 12-year period. This was contrary to their hypothesis that changes in epidemiology of bacterial infections and increased use of viral testing should have led to a decrease in LOS for these infants. The authors conclude that "targeted effort to raise awareness and implications of these issues in the care of inpatients"[1] is needed.

If the authors' hypothesis is correct (that LOS should have decreased and did not), our field has work to do. If we have failed to appropriately shorten LOS in a population deserving of it, then we are falling short of adequately using the tools and knowledge at our disposal to meaningfully adapt our practice, which would be concerning. However, we must critically assess the 2 points made by the authors with regard as to why a shorter LOS was hypothesized for well-appearing, febrile infants: (1) a decrease in prevalence of bacterial infections in this patient population and (2) changes in the use of viral testing.

The authors operate under the assumption that the epidemiology of serious bacterial infection (SBI) has changed and that prevalence has decreased, suggesting that this, in turn, should result in shortened LOS. Although changes in epidemiology have been fairly strongly supported in the literature over the past decades, such as a decline in the proportion of infections caused by *Listeria monocytogenes* and rise in the proportion of those caused by *Escherichia coli*,[2–5] variations in causative organisms do not necessarily mean that the overall prevalence of SBI has changed. In fact, there is a paucity of data to support the assertion that the overall prevalence of bacterial meningitis and/or bacteremia (the 2 occult bacterial infections for which these infants generally remain hospitalized pending culture results and evaluation) declined during the study period. For example, with regard to invasive infections caused by late-onset group B *Streptococcus* (after 72 hours of life), prevalence was stable at 0.3 cases per 1000 live births from 2000 to 2012.[6] Similarly, rates of invasive infections from *Haemophilus influenza*

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have not significantly changed over this time period.[6] Although we found few studies in which researchers examined the prevalence of bacteremia or meningitis in well-appearing infants during the authors' study period, since the early 1990s, the rate of bacteremia in infants presenting with fever without a source has been shown to be consistently between 1% and 4% regardless of the year of data collection, and a similar story is found in bacterial meningitis, for which the rate has generally been <1.5% over the previous decades.[7–14] The theory that prevalence of SBI, specifically bacteremia and meningitis, decreased from 2000 to 2012 does not appear to be supported in the literature.

With regard to whether changes in viral testing should have resulted in a shortened LOS during the study period, this really is not as simple as stating that more viral testing was likely available, so more testing should have been done, and LOS should have been shortened on the basis of the results of this testing. Over the past 10 to 15 years, the use of polymerase chain reaction and nucleic acid tests allowed more timely and accurate detection of a variety of viral illnesses.[15] However, it is not clear to what extent these tests were available, and if they were available, whether results would have returned rapidly enough to impact LOS. It is also not clear, or at least it was not clear a decade ago, how these tests should be used by providers to influence LOS. Although it is generally accepted that febrile infants with a documented viral infection are less likely to have a concurrent SBI than other febrile infants,[16,17] the first large-scale data in which researchers incorporated these tests into a clinical algorithm for febrile infant management were not published until after the authors' data collection period.[18]

The authors speculate that viral testing might have been limited by personal factors such as experience, practice patterns, or medicolegal concerns. This is possible, although it has also been suggested that clinicians may be less likely to admit to the hospital or use antimicrobial agents on well-appearing febrile infants with an identified respiratory virus.[19] It may also have been that respiratory viral testing simply was not available during the study years at many of these institutions or that the turnaround time for this testing was prohibitive, such that it did not meaningfully impact LOS, particularly if this testing had to be sent to an outside laboratory. We agree with the authors that appropriate use of viral testing may be a path toward reducing LOS, particularly as others have identified a viable model for incorporating viral testing into the evaluation of a febrile infant.[18] However, it is not clear to what extent viral testing had been incorporated into clinical algorithms and practice over the course of the study time frame, nor is it clear that providers knew what to do with a positive test result, so it seems unfair to suggest that viral testing should have resulted in a decreased LOS from 2000 to 2012 for these infants. It may be likely that today respiratory viral testing is used much more frequently to impact LOS, but the data from the study by Zangwill et al[1] are older and were collected at a time during which many of the tests used today were being developed, thus limiting the conclusions we can draw.

Finally, it should be noted that we know of no new widely used guidelines for well-appearing, febrile infant management published during the study period, but several have been published since, suggesting that the incorporation of viral testing into febrile infant management took some time and may now be different from what it was from 2000 to 2012.[18,20]

We agree with the authors that this is an area of interest in our continued efforts to provide cost-effective, evidence-based care to this population, but we contend that the time period of their study makes it difficult to draw reliable conclusions regarding the reasons behind the lack of change in LOS. The evidence base used to support best practice for these infants is stronger now than it was in the early and mid-2000s. Additionally, viral testing is more sophisticated, and the use of such testing is better understood. Since 2012, comprehensive national and local quality improvement efforts have targeted this patient population, and today, hypothesizing an appreciable decline in LOS would be justified. If this study is repeated by examining data from 2012 to 2018 and researchers identify similar results, then the authors' conclusions about additional quality improvement efforts and evidence-based interventions would be justified.

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