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Expected Practice as a Novel Antibiotic Stewardship Intervention

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“Expected practice” is a recently described method to alter clinical behavior. We implemented an expected practice around short-course antibiotic therapy, which was associated with decreased antibiotic utilization for multiple bacterial infections. Thus, we describe this expected practice as a novel, simple, and inexpensive tool to enhance antibiotic stewardship.

Keywords: antibiotic stewardship; expected practice; quality improvement.

Society faces an ongoing crisis of antibiotic resistance, fueled by overuse of antibiotics. Nevertheless, recent studies have found that antibiotics are increasingly prescribed [1–3]. New strategies, particularly psychological tools to alter provider behavior, are needed to enhance the effectiveness of antibiotic stewardship efforts [4, 5].

One way to improve antibiotic utilization is to prescribe courses for only as long as necessary to optimize cure rates [6, 7]. Multiple randomized controlled trials have found that shorter courses of antibiotic therapy result in similar cure rates as traditional courses for many types of infections, including urinary tract infections (UTIs), skin and soft tissue infections (SSTIs), and pneumonia (PNA) [7]. Unfortunately, familiarity with short-course therapy as a stewardship tool is limited. A recent study found that only one-third of infectious diseases practitioners from 58 countries recommended short-course therapies [8]. Furthermore, primary providers may be concerned that they, and not the stewardship team, face the consequence of adverse outcomes of treatment decisions. Thus, fear of being blamed for the consequences of shortening durations of therapy, combined with lack of familiarity of evidentiary basis, may inhibit uptake of this stewardship tool.

One mechanism that can simultaneously educate providers regarding evidenced-based practice while also establishing an institutional requirement for standard practice is “expected practice” (EP) [9]. Expected practices set an institution’s expectation for how its providers practice medicine, and hence set stronger standards of care compared with clinical guidelines, which are typically viewed more as literature-based suggestions or expert consensus. Expected practices are developed and implemented by coalitions of primary and specialty care experts and approved by system-wide leadership committees, so they take on official expectations of the medical staff and hospital leadership. We developed and implemented a novel expected practice for shorter-term antibiotic courses for standard infections. We sought to determine the impact of this expected practice on antibiotic prescribing behavior at our large, tertiary care, public hospital.

METHODS

Development and Implementation of the Expected Practice

Our expected practice on antibiotic durations (Supplementary Figure 1) was developed with input from primary care and infectious diseases committees, with final approval by the hospital’s Pharmacy and Therapeutics Committee and Medical Executive Committee. The expected practice was then posted electronically on the hospital’s intranet and disseminated via memo from the hospital’s Chief Medical Officer to all credentialed providers. Hospital-wide implementation began in October 2016, and the only form of subsequent reinforcement was through the existing daily stewardship rounds.

Existing Antibiotic Stewardship Activities

Our institutional antimicrobial stewardship program (ASP) includes prospective audit and feedback, antimicrobial restriction, and de-escalation rounds. There were no changes to this program during the baseline and interventional study periods. The only other new antibiotic stewardship initiative that started contemporaneously at the hospital was procalcitonin testing, which was implemented December 2016, after the expected practice was implemented.

Study Design and Setting

We conducted this quasi-experimental, pre/post quality improvement study at the Los Angeles County + University of Southern California (LAC+USC) Medical Center, a 676-bed public teaching hospital in downtown Los Angeles. The study was determined to be not human subjects research by the University of Southern California Health Sciences Campus Institutional Review Board.
We established baseline outcomes by collecting all adult (age > 18 years) inpatient visits for a 12-month period before expected practice implementation in October 2016 (patient visits with a discharge date between October 1, 2015, and September 30, 2016). We treated the month of October as a burn-in period for the newly implemented expected practice and collected inpatient visits for the following 12 months (patient visits with a discharge date between November 1, 2016, and October 31, 2017). Any patients whose inpatient visit spanned both the baseline and the postimplementation period were excluded.

We selected patients for inclusion if any of the first 20 discharge diagnoses included ICD-10 codes for the 4 infectious diseases of interest: UTIs (cystitis N30.0*/N30.9*; UTI N39.0; pyelonephritis N10), SSTIs (cutaneous abscess L02; cellulitis L03), PNA (J13-J18), and ventilator-associated pneumonia (VAP; J95.851).

Main Outcome and Measures
Our primary outcome measure was antibiotic days of therapy (DOT) [10]. We defined DOT as the sum total of days of each antibiotic administered as an inpatient plus the outpatient days prescribed upon hospital discharge (ie, 2 antibiotics given for 10 days = 20 DOT). Our secondary outcome was total antibiotic exposure, defined as the sum total of milligrams of antibiotics administered as an inpatient plus the milligrams prescribed as an outpatient upon discharge from the hospital.

Statistical Analysis
We reported patient characteristics using summary statistics without inferential measures [11]. To adjust for covariates, we used a 0-truncated negative binomial multivariable regression to deal with overdispersion in the data. For each infection type, we modeled average duration of antibiotic therapy as a function of the presence of the expected practice in a pre/post fashion. For the primary analysis, we censored the small number of patients who had DOTs >90 days as being reflective of unusually complex hospital courses not relevant to the expected practice; we also ran a sensitivity analysis censoring >30 days of DOTs, and this did not meaningfully change the results. We adjusted for covariates (age, gender, insurance status, in-hospital mortality, and use of procalcitonin testing) and for severity of illness using a number of risk adjustment measures (Medicare Severity Diagnosis Related Group Relative Weights, intensive care unit days, in-hospital mortality, and expected mortality according to the 2017 Mortality Expected Risk Model from the Vizient Consortium, Irving, TX). We assessed in-hospital mortality as a balancing/safety measure, to determine if shortening antibiotic therapy resulted in patient harm, by logistic regression.

RESULTS
The patients in the pre- and post-EP periods were similar demographically and with respect to disease severity (Table 1). When adjusting for all covariates of interest, average antibiotic DOT and antibiotic dose exposures significantly decreased for each of the studied diseases after introduction of the expected practice (Table 2). The point estimate of the decrease in average antibiotic DOT was 10%, 11%, 11%, and 27% for UTIs, SSTIs, pneumonia, and VAP, respectively (Table 1). Decreases in antibiotic exposure (mg) were larger, at 17%, 13%, 29%, and 35% for UTIs, SSTIs, pneumonia, and VAP, respectively.

We ran a sensitivity analysis to determine if the intervention's impact waned over time (change in duration of therapy in the second half of intervention vs baseline year). For UTIs and PNAs, we found no significant difference in the shortening of therapy in the second half of the intervention year. For SSTIs and VAPs, the shortening of therapy was not statistically significant in the second half of the intervention vs baseline year compared with

| Table 1. Characteristics of the Patients at Baseline and Postintervention |
|-----------------------------|-----------------------------|
| Variable                  | Baseline | Postintervention |
| Patient visits, No.        |          |                |
| UTI                       | 1562     | 1512           |
| SSTI                      | 1378     | 1292           |
| PNA                       | 1184     | 1250           |
| VAP                       | 55       | 73             |
| Age, median (IQR), y       |          |                |
| UTI                       | 57 (45 to 68) | 57 (43 to 68) |
| SSTI                      | 50 (39 to 58) | 49.5 (38 to 58) |
| PNA                       | 57 (46 to 68) | 57 (47 to 67) |
| VAP                       | 54 (37 to 64) | 56 (40 to 64) |
| Female gender, No. (%)     |          |                |
| UTI                       | 913 (58) | 880 (58)       |
| SSTI                      | 367 (27) | 359 (28)       |
| PNA                       | 432 (38) | 463 (37)       |
| VAP                       | 15 (27)  | 20 (27)        |
| Medicaid/Medicare, %/%     |          |                |
| UTI                       | 72/20    | 73/21          |
| SSTI                      | 82/8     | 79/12          |
| PNA                       | 69/21    | 70/21          |
| VAP                       | 64/22    | 71/18          |
| DRG relative weight, median (IQR) | | |
| UTI                       | 1.16 (0.98 to 1.79) | 1.17 (0.93 to 1.77) |
| SSTI                      | 1.11 (0.84 to 1.75) | 1.27 (0.84 to 1.77) |
| PNA                       | 1.79 (1.43 to 2.63) | 1.77 (1.32 to 2.45) |
| VAP                       | 5.13 (2.30 to 10.94) | 5.11 (3.25 to 10.92) |
| Expected mortality, median (IQR), % | | |
| UTI                       | 0.75 (0.18 to 2.2) | 0.75 (0.18 to 2.4) |
| SSTI                      | 0.18 (0.05 to 0.88) | 0.19 (0.05 to 1.05) |
| PNA                       | 1.4 (0.55 to 5.7) | 1.5 (0.50 to 5.6) |
| VAP                       | 10.3 (1.3 to 24.3) | 10.4 (2.1 to 30.5) |
| Procalcitonin ordered, No. (%) | | |
| UTI                       | N/A      | 276 (18)       |
| SSTI                      | N/A      | 157 (12)       |
| PNA                       | N/A      | 587 (47)       |
| VAP                       | N/A      | 47 (64)        |

Abbreviations: DRG, diagnostic-related group; IQR, interquartile range; PNA, pneumonia; SSTI, skin and skin structure infection; UTI, urinary tract infection; VAP, ventilator-associated pneumonia.
the first half; however, the duration still trended shorter in the second half of the intervention vs baseline year, and the analysis was underpowered as it was based on only half a year of data.

Interestingly, use of procalcitonin testing was associated with increased antibiotic DOT and dose exposure, and this effect was statistically significant in all disease groups except SSTIs. Thus, initiation of procalcitonin testing did not confound the improvements in antibiotic utilization observed in the intervention period. Finally, mortality did not change postintervention (Table 1).

DISCUSSION

We describe a substantial reduction in duration of therapy for common, acute bacterial infections after introduction of an expected practice, with no change in mortality. We chose to use an expected practice around durations of therapy because providers expressed concern that they would be individually exposed to blame if they prescribed short-course antibiotic therapy and the clinical outcome was bad. The expected practice document lists the randomized controlled trials that underpin the expectation in practice. It also sets a standard of practice that the medical staff of the hospital and hospital leadership expect to be complied with unless specific contrary circumstances are documented in the chart. As such, the expected practice has alleviated concerns by our providers regarding both what the evidentiary basis of the practice is and the knowledge that they are acting in compliance with practice standards our institution has set. The expected practice required no technology and cost no money to implement with practice standards our institution has set. The expected practice has alleviated concerns by our providers regarding both what the evidentiary basis of the practice is and the knowledge that they are acting in compliance with practice standards our institution has set. The expected practice required no technology and cost no money to implement with practice standards our institution has set. The expected practice has alleviated concerns by our providers regarding both what the evidentiary basis of the practice is and the knowledge that they are acting in compliance with practice standards our institution has set. The expected practice required no technology and cost no money to implement with practice standards our institution has set. 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improve their prescribing behavior because they know they are being monitored. However, such an effect would still be a positive impact of the intervention if it could be sustained. Our sensitivity analysis showed no evidence of waning effect for UTIs or PNAs; a possible waning effect was seen for SSTIs and VAP; however, the intervention still trended toward benefit vs the baseline period in the second half of the year, despite smaller sample sizes and an underpowered comparison (only half the year). Another limitation is lack of data on infection relapses or readmissions. Nevertheless, we found no change in mortality, and short-course antibiotic interventions have been found safe to implement in multiple randomized controlled trials [7].

In summary, we report that implementation of an expected practice for shorter-course antibiotic regimens, supported by our antibiotic stewardship team, was associated with a marked decrease in antibiotics prescribed for common, acute bacterial illnesses. Expected practice is a promising new psychological tool to promote effective antimicrobial stewardship.

**Supplementary Data**

Supplementary materials are available at Open Forum Infectious Diseases online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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