Increasing Tdap Coverage Among Postpartum Women: A Quality Improvement Intervention

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abstract

BACKGROUND AND OBJECTIVE: Infants are at greatest risk for severe disease and death from pertussis; most acquire it from household contacts. Centers for Disease Control and Prevention guidelines recommend tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (Tdap) vaccination for infant caregivers, especially postpartum women who did not receive it during pregnancy. Our objective was to increase the percentage of women receiving Tdap vaccine before postpartum discharge.

METHODS: An interdisciplinary workgroup identified barriers to improvement of postpartum Tdap vaccination from which a 5-step intervention was created: (1) provide education on Tdap and pertussis; (2) offer Tdap throughout hospitalization; (3) create a Tdap standing order; (4) keep Tdap as floor stock; and (5) document administration. Pre- and postintervention data were collected from monthly chart reviews. Our main outcome measures were the proportion of postpartum women eligible for Tdap and the proportion of those eligible who received Tdap.

RESULTS: Preintervention baseline data (202 charts) described 166 postpartum women eligible to receive Tdap. Of the eligible women, 91 (55%) received the Tdap vaccine. During the 9-month postintervention period, 844 charts were reviewed (average, 93 per month; range, 82–104). Of the 632 women eligible to receive the Tdap vaccine, 462 (73% overall [range, 67%–79%]) received it. Thirty-three percent more postpartum mothers received the Tdap vaccine before discharge in the postintervention period ($P < .01$). The percentage of women eligible decreased from 82% to 75%.

CONCLUSIONS: This quality improvement initiative substantially increased Tdap immunization in the immediate postpartum period. Efforts to increase immunization during pregnancy for passive transfer of maternal antibodies remain preferable.

Infants have the highest incidence of pertussis and are at greatest risk for severe disease and death from this disease. In 2014 alone, the rate of pertussis among infants aged <6 months was 150.9 per 100 000.[1] Approximately three-quarters of infants with pertussis acquire the infection from a household contact,[2] and almost one-half of infants aged <1 year who are diagnosed with pertussis are hospitalized.[3]

In 2006, the US Advisory Committee on Immunization Practices (ACIP) recommended immediate postpartum vaccination of all mothers and caregivers against tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed (Tdap), to reduce the number of

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Dr Bernstein conceptualized and designed this quality improvement project, conducted the analyses, and drafted, critically reviewed, and revised the manuscript; Dr Monty helped with the analysis and interpretation of data, contributed to the initial draft of the manuscript, and critically reviewed the manuscript; Ms Yang made substantial contributions in the conceptualization, design, and coordination of the study and critically reviewed the manuscript; and Ms Cohen helped in the conceptualization, design, analysis, and interpretation of data for the study and critically reviewed and revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

DOI: 10.1542/peds.2016-0607

Accepted for publication Aug 29, 2016

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

To cite: Bernstein HH, Monty M, Yang P, et al. Increasing Tdap Coverage Among Postpartum Women: A Quality Improvement Intervention. *Pediatrics.* 2017;139(3):e20160607

sick household contacts.[3] The effectiveness of this "cocooning" strategy has not been documented. In fact, there has been a substantial increase in pertussis cases, peaking in 2012 with >40 000 pertussis cases and a total of 20 deaths, 16 of them infants aged <11 months.[4] Subsequently, the ACIP updated its guidelines to include Tdap vaccination for all pregnant women during each pregnancy, due to the short-lived protection provided by the vaccine.[5] A recent study among several health systems in the Midwest and West showed that Tdap vaccination during pregnancy increased from ~10% in 2007 up to 41.7% in 2013.[6] However, according to an opt-in, nationwide Internet panel survey administered by the Centers for Disease Control and Prevention (CDC), only ~14% of pregnant US women aged 18 to 49 years surveyed during the 2013–2014 flu season and 23% of pregnant women during the 2014–2015 flu season received the Tdap vaccine during their pregnancy.[7,8] At a local level, preintervention chart audits of 202 women who delivered at our hospital in 2012 revealed that 18% of women received the Tdap vaccine during pregnancy. Of the 166 women eligible for Tdap vaccine after delivery, 45% did not receive it before hospital discharge.

The purpose of the present project was to identify and address barriers to universal Tdap vaccination among eligible but unvaccinated postpartum women in a high-volume suburban hospital. Our aim was to increase the proportion of eligible postpartum women who received the Tdap vaccine before discharge by 50% compared with baseline. An interdisciplinary team, including experts in information systems, quality improvement (QI), clinical medicine, infectious diseases, and pharmacy, helped create our multifaceted intervention to address system barriers.

METHODS

Setting

The Katz Women's Hospital at North Shore University Hospital is a 73-bed suburban women's hospital serving the diverse communities of both Queens and Long Island, New York, with >6500 annual deliveries. There are 4 postpartum units in the hospital staffed by nurses who manage patient care from admission through discharge. The high delivery volume at Katz ensured an appropriate preintervention and postintervention sample. The women's hospital is a local hub of the Northwell Health system (formerly North Shore–Long Island Jewish Health System) and would therefore serve as a resource-rich pilot center from which successful interventions could be disseminated to the obstetrical service line. The Northwell Health institutional review board approved our project through expedited review.

Planning the Intervention

This QI project began with securing leadership buy-in from the following: the chiefs of Obstetrics/Gynecology, Maternal-Fetal Medicine/Perinatology, and Neonatology; the Director of Infection Control; the Assistant Director of Hospital Pharmacy; and the Chief Medical Informatics Officer of the hospital. Ensuring leadership backing was crucial, as their support accelerated the progress of our project through references to key personnel and advice on how to obtain resources.

We assembled an interdisciplinary advisory committee of postpartum nurse managers, members from clinical information technology and analytics, and the Director of Patient Care Services to document the current process of Tdap administration. Our health system had no standardized procedure to ensure that pregnant or postpartum women received the Tdap vaccine. The obstetrics team would review maternal vaccine history to update necessary vaccines before discharge, but Tdap was not routinely offered on the postpartum floor, nor was there a uniform policy that encouraged receipt of this vaccine during pregnancy or on the labor and delivery floors. This advisory committee also served as a focus group, using their experiences to create a fishbone analysis identifying the causes of low Tdap vaccination rates and brainstorming strategies to overcome these barriers (Fig 1). Through this collaborative process, a 5-step intervention addressing barriers was created (Fig 2). An ad hoc workgroup of researchers, nurse managers, and nurse representatives from each postpartum unit, called "floor champions," met regularly to ensure implementation of the intervention and provide feedback on unanticipated challenges.

The Intervention

The first step of the intervention involved nurse-driven education of all mothers regarding pertussis and the Tdap vaccine upon their arrival to the postpartum floor. Nurses were first educated themselves by using a set of 4 PowerPoint slides on the epidemiology and stages of pertussis and the importance of vaccinating adults to cocoon more vulnerable infants. During the unit admission process, a copy of the CDC pertussis vaccine information statement was provided to pregnant mothers in the admission packet. Nurses were asked to introduce and emphasize the value of the Tdap vaccine and to reinforce the information found on the vaccine information statement. Step 2, also nurse-driven, involved offering the Tdap vaccine to each mother, educating her by using the educational slides and answering questions throughout the hospitalization. Nursing sign-outs included a brief report on the Tdap vaccination status of each patient. For step 3, our clinical

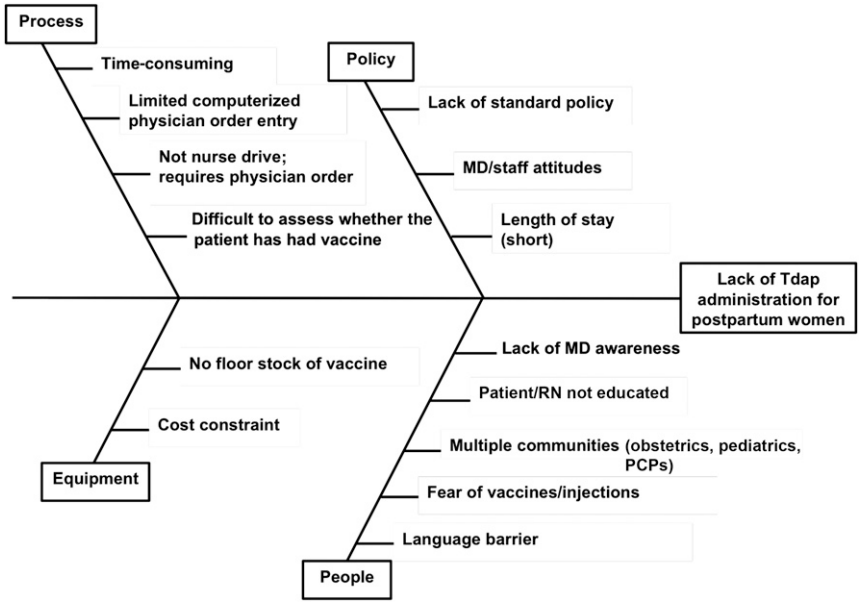

FIGURE 1
Fishbone analysis identifying the causes of low Tdap vaccination rates, performed by the multidisciplinary focus group. MD, medical doctor; PCP, primary care physician; RN, registered nurse.

information technology specialists created a standing order (ie, an order automatically included upon admission of each patient without requiring an individual order from the patient's physician) in the computer system to give the Tdap vaccine. Step 4 supplied floor stock of the Tdap vaccine so it could be administered throughout the hospitalization. This step was achieved and maintained through communication with the pharmacy department. The existing influenza vaccine policy had already established systems for proper vaccine inventory and storage of floor stock, and these systems were readily adapted for the Tdap vaccine. Step 5 emphasized documentation of vaccine administration in both the paper form and in the electronic medical record (EMR) instead of in one or the other, as was commonplace previously. This step was intended to ease the transition from paper charts to an EMR-only system and to create a more integrated and complete EMR. This comprehensive 5-step intervention was anticipated to eliminate the majority of identified barriers with its consistent implementation to optimize rates of Tdap receipt. All interventions were implemented simultaneously.

Floor champions regularly briefed unit nurses on the intervention at change of shift, ensuring integration of the intervention by holding

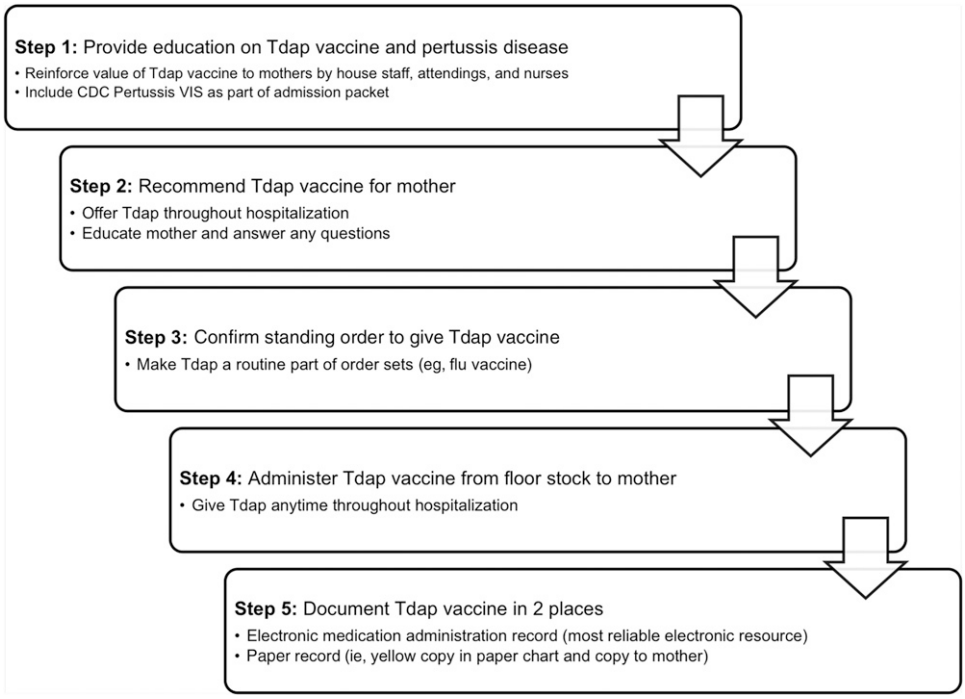

FIGURE 2
Intervention steps created by using the fishbone analysis.

meetings to discuss the initiative, address challenges, and provide one-on-one guidance. The ad hoc workgroup met weekly or biweekly to discuss successes, explore areas for improvement, and brainstorm methods to maximize unit participation. QI data were not provided to the staff during the course of the project.

Methods of Evaluation

The specific aim of the present study was to increase the rate of Tdap vaccination among eligible women. A woman was considered "eligible" if she did not receive the Tdap vaccine prenatally. All mothers admitted to the 4 postpartum units were included in our 5-step intervention. Tdap administration was documented through a paper form that mothers were asked to sign attesting to receipt of the Tdap vaccine and/or through the EMR. Tdap was counted as "received" if administration was documented through the paper form, the EMR, or both. Because there was wide discrepancy in where nurses recorded Tdap administration in the EMR, we surveyed nurses to establish the most convenient place in the EMR for documentation of Tdap receipt and confirmed this preferred place during the audit of Tdap coadministration with influenza vaccine (as described later). Only the preferred place in the chart was checked for documentation of Tdap administration when auditing charts.

To establish a preintervention baseline, a retrospective chart review was conducted to determine the number of women eligible to receive the Tdap vaccine and how many of those eligible received the vaccine before discharge from the postpartum floor. More than 200 patient charts between July and December 2012 were reviewed, equally distributed by week each month. In addition, 30 patient charts each from August 2012, when the influenza vaccine was not offered, and December 2012, when influenza vaccines were coadministered with Tdap, were examined. This subanalysis was used to determine whether Tdap vaccination rates changed in the context of coadministration with influenza vaccine.

Postintervention data on the number of women delivering a healthy term newborn, vaccine eligibility, and timing of receipt (prepartum or postpartum) were compiled from April 2013 through December 2013. The first 25 patients whose charts were available on the first, eighth, 15th, and 22nd of each month were audited, thereby selecting 100 charts per month with an equal distribution by week for each month. We enlisted the services of the information technology department to query the EMR for preintervention and postintervention data. However, the timing of this project coincided with a health system–wide transition to EMR, resulting in our query receiving low priority. Consequently, our researchers conducted manual chart reviews to collect all data. Floor champions informally collected nurse feedback to share with the ad hoc workgroup.

Analysis

To monitor the changes in the process over time, a control chart was created to plot the proportion of postpartum patients eligible for the vaccine and the proportion of eligible postpartum patients per month receiving the Tdap vaccine before discharge. The centerlines represent the overall average proportions; the 3-sigma control limits were calculated based on the binomial distribution (p chart). Overall rates of preintervention and postintervention Tdap vaccination receipt and nonreceipt were calculated separately for the 2 study phases to estimate the impact of the intervention. Qualitative data were gathered regularly during workgroup and advisory committee meetings to contextualize the experience of implementing these changes. From the inception of the project, monthly summaries were created to document lessons learned, anticipated barriers, and unexpected challenges. The data were analyzed by using JMP, Version 12 Pro (SAS Institute, Inc, Cary, NC).

RESULTS

Preintervention baseline data (202 charts) showed 166 postpartum women eligible to receive the Tdap vaccine before discharge; 91 (55%) received it and 75 (45%) did not receive it. Our retrospective subanalysis from August and December 2012 revealed no difference in vaccine administration rates between months without and with concomitantly offered influenza vaccine.

Initially, the admitting nurse was to offer the Tdap vaccine to each patient. However, given the unpredictable timing of patient arrivals, lengths of stay, and varied levels of maternal exhaustion, the ad hoc workgroup recommended the Tdap vaccine be routinely offered as part of the discharge procedure, a well-received change among nursing staff. Tdap education and discussion remained part of the admission process. Adding Tdap administration to the discharge procedure also facilitated step 5 because nurses were already documenting the patient's discharge in the EMR. Most nurses readily implemented the nurse-driven interventions, with all 4 postpartum units being equally enthusiastic. In cases in which enthusiasm and cooperation were below expectations, floor champions were available to provide support and education.

During the 9-month postintervention period from April through December 2013, a total of 844 charts were reviewed (average, 93 per month; range, 82–104). The Tdap vaccine was considered "received" if either the electronic or paper record documented vaccine administration. The percentage of eligible women

decreased from 82% to 75% (Fig 3). Of the 632 women eligible to receive the vaccine before discharge, 462 (73% overall [range, 67%–79%]) received and 170 did not receive (27% overall [range, 21%–33%]) Tdap postintervention. Thirty-three percent more eligible postpartum mothers ($P < .01$) received the Tdap vaccine before discharge (Fig 4).

DISCUSSION

Our aim was to increase the proportion of eligible postpartum women who received the Tdap vaccine before hospital discharge by 50% compared with baseline. We documented an increase from 55% to 73% between the preintervention and postintervention periods. Although we did not completely achieve our aim, this 5-step intervention was associated with a notable increase in maternal postpartum Tdap administration.

The fishbone analysis spearheaded by the advisory committee was the key to designing and establishing this intervention. Securing leadership buy-in from the early stages accelerated our progress. Including multidisciplinary personnel at several levels of project planning and intervention built widespread interest and harnessed the variety of perspectives and experiences each discipline could provide. Our project benefited from the immense enthusiasm of our floor champions. Maintaining open contact with the workgroup through weekly meetings was crucial to the successful implementation and adaptation of the intervention. As a result, we were able to adjust our original methods to streamline the intervention with existing workflow, as well as maintain local momentum. Overall, we were successful in achieving the goals of this QI initiative because patients were provided education and were offered the vaccine in a timely manner.

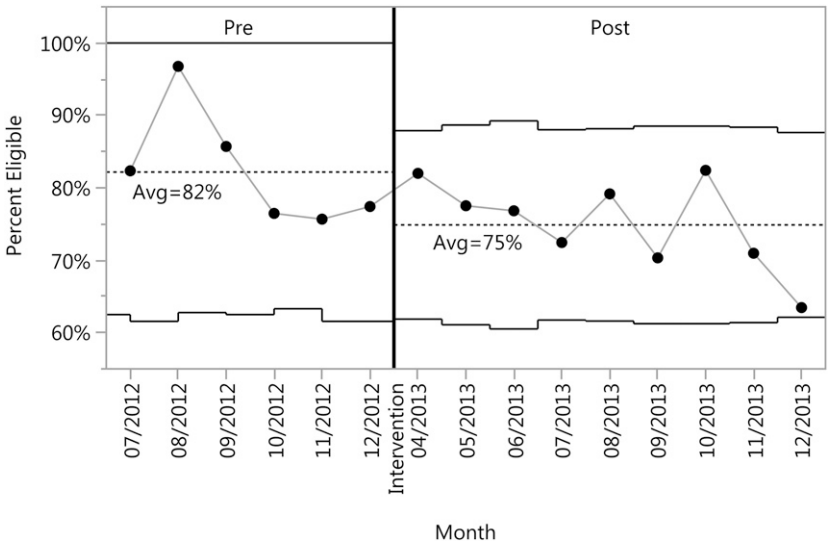

FIGURE 3
A p control chart for the percentage of postpartum women eligible to receive the Tdap vaccine preintervention and postintervention. Avg, average; LCL, lower control limit; UCL, upper control limit.

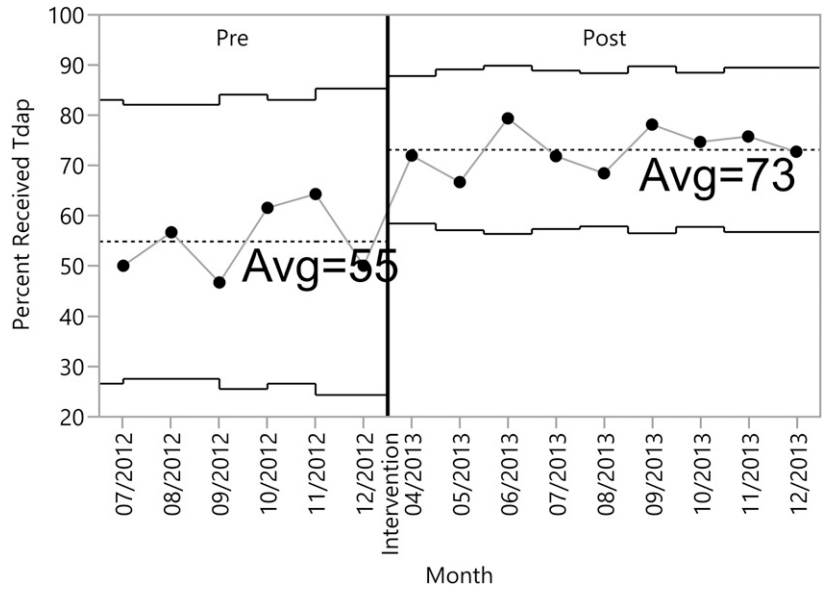

FIGURE 4
A p control chart for the percentage of eligible postpartum women who received the Tdap vaccine preintervention and postintervention. Avg, average; LCL, lower control limit; UCL, upper control limit.

Eligibility of women for Tdap vaccination after pregnancy decreased over the course of the study from 82% to 75% between the preintervention and postintervention periods. The topic of Tdap during and after pregnancy was gaining increased traction within the obstetrics department at the time of our study, particularly with the passage of state legislation making Tdap vaccination available to women at birth hospitals. These shifts likely resulted in more women receiving the vaccine during pregnancy and contributed to the decreasing proportion of women who were eligible for Tdap vaccine after delivery, with increased awareness among obstetricians for Tdap vaccine

during pregnancy. However, it is unlikely that these shifts would have substantially resulted in increased administration of the Tdap vaccine after pregnancy during our project.

Thirty-three percent more women received the Tdap vaccine in the 9-month postintervention data collection period, a statistically significant increase. The interdisciplinary advisory committee was instrumental to our success. With this committee's effort in clearly identifying barriers to vaccination, coupled with their understanding of the hospital system, we were able to create a realistic set of intervention steps. Such a committee is highly advisable in any future QI projects.

Throughout the course of planning the interventions, the majority of mutable barriers to improvement outlined in the original fishbone analysis were addressed. Barriers to the process of administering the Tdap vaccine were overcome by creating a nurse-driven intervention and a standard automatic order set that included the vaccine. Although the short lengths of stay were an ongoing constraint, the feedback provided by the nursing workgroup helped adjust the intervention to maximize effective contact during a patient's limited hospitalization. Equipment barriers were overcome with the cooperation of the hospital pharmacy, which provided floor stock to each postpartum unit. Through education and outreach, we attempted to address barriers such as patient fear of vaccines, lack of awareness and confusion about the vaccine among physicians and staff, and the hospital personnel's personal attitudes toward vaccination. Although efforts were generally met with enthusiasm and a high level of buy-in, not all staff could be reached. We attempted to address the lack of standard Tdap vaccination policy in our system by educating leadership on the most up-to-date recommendations.

Implementation barriers that were recognized included the time-consuming process of educating, offering, and administering the vaccine, as well as the range of attitudes of multiple physicians and staff caring for an obstetric patient through the peripartum and postpartum stages in our hospital. As with any new addition to workflow, the intervention was time-consuming. The impact of this issue subsided over time, as offering the vaccine became more of a practice standard in our hospital. By continuing to educate hospital leadership, we anticipate that the attitudes of care providers will coalesce in favor of routinely offering the vaccine. Expanding the intervention to an earlier point of contact (eg, during pregnancy) should eliminate this barrier entirely.

In the future, interventions can be streamlined into the existing workflow. This approach would require an automated system of documentation and ensuring availability of floor stock, without the necessity of weekly meetings by an interdisciplinary team. Gathering a well-represented nursing workgroup to oversee and provide feedback was key to the successful launch of this 5-step intervention. These meetings required dedicated time on the behalf of all participants, as well as effort throughout the day to gather information and provide feedback. Once the steps of the intervention were integrated into the standard daily workflow of the postpartum floor, more time-intensive tasks such as workgroup meetings became less of a priority. Furthermore, the process of manual data collection was time-consuming without an automated data query. Consideration could also be given to reviewing a fewer number of charts per month.

Other QI efforts centered on increasing vaccination rates among the pediatric population are also using multi-step interventions to capture and treat patients/populations. Interventions addressing parent education, clinical informatics, and availability are achieving successful outcomes. One study implemented a customized 5-step intervention (ie, including education of staff and parents, visual and electronic alerts, multidisciplinary participation) that resulted in an increase in influenza vaccination by 64.5% among pediatric patients with cancer.[9] Another examined the success and sustainability of a variety of interventions used at each of 6 health centers in Washington, DC; these interventions included family reminders, education, increased access to vaccines, and coordination of care. All 6 centers showed an increased immunization rate after implementation of the interventions and sustained improvement beyond 18 months.[10]

In contrast, interventions focused solely on patient education have seen limited success. Patients in several obstetrics outpatient practices in Georgia were educated in the waiting room using interactive materials via an iPad, as well as brochures and posters. A vaccine champion, typically a nurse, was made available to answer questions and was provided with appropriate talking points. Antenatal vaccination rates for both Tdap and influenza were higher in the intervention group, although not statistically significant.[11] A mixed practitioner- and patient-based intervention from the American Congress of Obstetricians and Gynecologists was more successful than a patient-centered educational approach; members who received educational materials about the benefits of Tdap vaccination in pregnancy, described as an immunization toolkit, in their practice locations were significantly more likely to offer their patients the Tdap vaccine.[12]

Our study relied on the experiences and perspectives of a variety of health care personnel, which helped

in devising the most efficient and useful intervention steps. Utilizing interdisciplinary groups as a vehicle for creating successful QI interventions is an ongoing area of research. Thus far, such groups have proven potentially effective in outpatient practices.[13] A team-based approach was similarly successful in a Boston, Massachusetts, pediatric practice, where full immunization of children aged 24 months reached 95%. The investigators attributed their success to a multidisciplinary team effort, the implementation of a patient registry, and comprehensive care coordination.[14] Although our study also relied heavily on an interdisciplinary team approach to identify and implement our interventions, we did not implement a patient registry given the information technology constraints at our facility.

Our results are subject to some limitations. The initiative was conducted in a single suburban women's hospital in an affluent area and near a major metropolitan hub. Although this setting provided for a highly active postpartum service, the singularity of the setting may limit the generalizability of our intervention. Nonetheless, the insights gained from our experience can guide the application and study of future similar initiatives in health care settings of various sizes.

Our study design also had the potential for bias. Observer bias (Hawthorne effect) among the nursing staff on postpartum units may have played a role with the initial rollout of our intervention. The efforts to minimize this bias, however, would have diminished the commitment of the implementation staff. Modifying workflow pattern is an intensive process in the early stages, as floor staff members adjust daily practice to accommodate changes. We suggest that a measure of observer bias was necessary to create the momentum necessary to efficiently implement the interventions into the daily workflow.

Furthermore, we noted that ability of staff to engage with this project was dependent on the level of activity and responsibilities of the nurses on a given floor during a given shift. We were unable to document balancing measures such as increased nurse work burden, which could affect level of participation, or more costs to the institution. However, our results show that this initiative is feasible for staff with its interventions involving adjustments in workflow and emphasis of education provided by nurses but little additional work after initial training.

CONCLUSIONS

Open communication, broad involvement by multiple project members, securing leadership buy-in, and flexible interventions were key lessons learned in the present study. By valuing the input of all project personnel, a successful 5-step intervention was devised, integrated, and adapted in the field. Although the intervention is appropriate for a large hospital with high patient turnover, we anticipate adjustments are possible when addressing barriers in smaller community hospitals with a different peripartum and postpartum floor dynamic. The accomplishment of our interdisciplinary advisory committee is applicable to all facilities with QI ambitions. Educating and extending outreach to hospital leadership is a strategy that can be applied to any QI project that relies on the cooperation of several divisions within a system. A larger hospital setting requires this approach, as a greater number of entities are involved in the planning and implementation of interventions.

After demonstrating the effectiveness of the 5-step intervention in our women's hospital, we expect to expand to labor and delivery. Although vaccinating women after delivery is a positive step, ACIP guidelines recommend vaccination of women during pregnancy.[5] Future initiatives will look to earlier points of contact with each pregnant patient to maximize early and efficient vaccination or could test vaccination promotion among other family members of newborn infants to increase cocooning.[15] Furthermore, additional research is required to understand the attitudes of patients who do not wish to receive the Tdap vaccine along with staff who are uncomfortable offering the vaccine. Study of how physician and nurse biases may influence patient encouragement and education on the benefits and risks of vaccination is also warranted.

ACKNOWLEDGMENTS

Tara Allen, Tsivia Boim, Carol Cosentino, Anne Hurtnole, Rose Robinson, and Christine Yard are all registered nurses who served as essential members of the ad hoc workgroup and floor champions. We are indebted to their hard work and enthusiasm in successfully implementing this intervention. A special thanks to Cathy Spino, PhD, for her statistical analysis expertise. The detailed editorial assistance of research assistants Elisabeth Seyferth, Karampreet Kaur, Rebecca Schneyer, and Catherina Yang is greatly appreciated.

ABBREVIATIONS

ACIP: Advisory Committee on Immunization Practices
CDC: Centers for Disease Control and Prevention
EMR: electronic medical record
QI: quality improvement
Tdap: tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis, adsorbed

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

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Pediatrics 2017;139;
DOI: 10.1542/peds.2016-0607 originally published online February 8, 2017;

PEDIATRICS®
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