Increasing influenza immunization rates among healthcare providers in an ambulatory-based, University Healthcare Setting

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Abstract

Objective: Despite its ‘best practice’ status as an intervention to combat healthcare-related influenza, many healthcare personnel (HCP) do not seek vaccinations themselves. The objective of this study was to achieve the Healthy People [HP] 2020’s influenza vaccination goal of 90% among our HCP.

Design: The study utilized the model for improvement, consisting of Plan-Do-Study-Act (PDSA) cycles. Each influenza season served as a PDSA cycle until the HP 2020 vaccination goal was achieved. The quality improvement (QI) study was conducted over four influenza seasons (i.e. 2014–15; 2015–16; 2016–17 and 2017–18).

Setting: The study’s setting was an ambulatory-based, university health center within a suburban university located in central New Jersey.

Participants: Adapting the National Vaccine Advisory Committee’s definition of HCP, clinical and non-clinical staff members (n = 110) participated in the QI-study.

Interventions: QI-interventions were centered on staff education/outreach, improved accessibility to influenza vaccines and frequent communication to staff over several PDSA cycles.

Main Outcome & Results: The QI-interventions significantly increased our overall vaccination coverage on our influenza vaccination status survey from 70.2% (2011–14 influenza seasons; n = 102) to 84.9% (2014–15 influenza season; n = 93) in PDSA 1, and 91.1% (2015–16 influenza season; n = 90) in PDSA cycle 2 ($\chi^2 = 309.53, P < 0.001$). Vaccination rates remained above the 90% performance goal during our quality control/assurance measuring periods (i.e. the 2016–18 influenza seasons).

Conclusions: This study demonstrates that influenza vaccination coverage can significantly improve among HCP through the application of concurrent and multifaceted QI-interventions.

Key words: quality improvement, influenza vaccination, healthcare-associated infections
Introduction

Influenza is a significant public health problem. Annual influenza-associated deaths range from 3000 to 49 000 according to recent estimates, and more than 200 000 people of all ages are hospitalized each year for respiratory illnesses and heart conditions associated with seasonal influenza infections [1]. Immunization is the most effective method for preventing infection from influenza and possible hospitalization. Since the 1980s, the Advisory Committee on Immunization Practices has recommended annual influenza vaccination for healthcare personnel (HCP) [2]. Vaccination can prevent influenza-related illness and work absenteeism among HCP [3], making it an efficient and cost-effective method toward improving organizational health and quality of care for patients and staff, alike. Even though vaccination has been established as a ‘best-practice’ in preventing healthcare-associated influenza and possible hospitalization or death, many HCP are not vaccinated each year [1].

Influenza vaccination coverage among HCP has improved over this past decade; this is certainly a promising development [4, 5]. Still, despite this trend, coverage remains well below the national Healthy People (HP) 2020 target of 90% [1, 6]. When vaccination is mandated as a condition of employment, coverage rates among HCP have been shown to rise to 90% [7]. A meta-analysis of 46 studies observed that mandatory influenza vaccination was the most effective intervention in driving coverage among HCP followed by declaration statements [8]. Despite the effectiveness of employer-mandated influenza vaccination policies in improving coverage, the ethics of this intervention has been strongly contested among healthcare professionals [9–14]. Mandatory influenza vaccination policies can create resentment and opposition among HCP [15].

Exploring alternative approaches to mandatory vaccination is a worthwhile endeavor. Alternative approaches and interventions may prevent employee turnover and disengagement while improving the quality of care across many healthcare settings. In the absence of mandatory employee vaccination policies, no studies to date have achieved or reliably maintained the HP 2020 influenza vaccination goal. Set within the context of university healthcare, the present quality improvement (QI) study represents the first known effort to use concurrent and multifaceted strategies successfully to achieve and maintain the HP 2020 coverage goal.

Methods

Context

The study’s setting was an ambulatory-based, university health center within a suburban university located in central New Jersey. The QI-study was conducted over four influenza seasons (i.e. 2014–15; 2015–16; 2016–17 and 2017–18). The health center averaged employing 110 staff members, serving ~6541 students, 1670 combined staff and faculty, and engaged in 75 859 patient visits annually during the study. Vaccination uptake in our healthcare center had not been measured prior to the study. In August 2014, adapting the National Vaccine Advisory Committee’s [1] definition of HCP, which includes clinical and non-clinical staff, all staff members were invited to participate in a pre-intervention survey on influenza vaccination status. The survey was online, anonymous and served to establish a baseline. The baseline survey consisted of 27-items measuring vaccination status for the 2011–12, 2012–13 and 2013–14 influenza seasons. The survey contained questions aimed at understanding barriers toward vaccination, and assessing level of knowledge regarding influenza and vaccination. Among the 110 staff members employed over the study, three individuals were excluded from data analyses (i.e. vaccination rates and survey response rates) due to self-reported medical contraindications (n = 2) and religious exemption (n = 1).

Interventions

Of the 102 respondents, nearly 30% reported within the baseline survey that they were not vaccinated in previous (2011–12, 2012–13 and/or 2013–14) influenza seasons. Therefore, the purpose of this study was to increase vaccination uptake among our HCP using evidenced-based QI-interventions [16]. An improvement team consisting of the health center’s director of QI and two nurse practitioners with infection control expertise, was formed. The team surveyed and subsequently analyzed (in September 2014) data pertaining to the reported barriers to vaccination. Using CDC [17] recommendations as a guide, evidence-based interventions were then developed to address barriers of vaccination among our HCP (see Table 1). The interventions promoted system-wide QI strategies focusing on education/outreach, increased accessibility/availability and communication.

The first intervention adapted from the CDC pertained to strategies focused on education and outreach [17]. The QI-study team

Table 1 Yearly influenza vaccination rate among HCP working within our ambulatory-based, university health service (UHS).

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<tr>
<td>UHS Performance, vaccination rates among survey respondents: % (number reported being vaccinated/total respondents from survey).</td>
<td>70.2% (71.6/102)</td>
<td>84.9% (79/93)</td>
<td>91.1% (82/90)</td>
<td>90.4% (94/104)</td>
<td>90.2% (92/102)</td>
</tr>
<tr>
<td>UHS Performance, intention to treat vaccination rates: % (number reported being vaccinated/total number of employees eligible for vaccination).</td>
<td>68.9% (71.6/104)</td>
<td>76.0% (79/104)</td>
<td>78.9% (82/104)</td>
<td>90.4% (94/104)</td>
<td>88.5% (92/104)</td>
</tr>
<tr>
<td>CDC Vaccination Coverage Benchmark 1: % all individuals 18+ vaccinated.</td>
<td>41%</td>
<td>43%</td>
<td>42%</td>
<td>43%</td>
<td>39%</td>
</tr>
<tr>
<td>CDC Vaccination Coverage Benchmark 2: % all HCP vaccinated.</td>
<td>71%</td>
<td>77%</td>
<td>79%</td>
<td>79%</td>
<td>–</td>
</tr>
<tr>
<td>Healthy People 2020 Performance Goal for QI-Study.</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Note: PDSA represents each Plan-Do-Study-Act cycle and QA represents each quality assurance/control period within the current QI-study. A dash was used under QA2 because CDC data for HCP were not available for the full influenza season during the 2017–2018 influenza season. CDC influenza vaccination coverage data can be found within the following website: https://www.cdc.gov/flu/fluvaxview/1718season.htm.
created an influenza vaccination ‘fact sheet,’ which contained information about the benefits of vaccination, potential consequences of illness for HCP and their patients, descriptions of influenza’s epidemiology and modes of transmission [17]. The fact sheet directly addressed myths about getting sick or acquiring influenza from the vaccine. The ‘fact sheet’ was sent to staff electronically (this intervention was implemented each October during the study). Education included direct visits and outreach to health center departments to review ‘fact sheet’ items, discuss rationales in support of vaccination (e.g. protecting of patient health and preserving healthcare infrastructure) and to address personal concerns over vaccine safety and efficacy [3, 16].

The second intervention focused on CDC recommendations to improve vaccine accessibility/availability [17]. Prior to this study, influenza vaccinations were available at no cost to all staff. Therefore, ‘free’ vaccination was not considered an intervention. However, influenza vaccines were made readily available to all night staff working within our after-hours care unit, and delivered to staff working in satellite facilities upon request. Health-center employees were also encouraged to attend the university’s annual influenza vaccination clinics each October, at which staff and students received free influenza vaccinations at no cost. The third intervention adapted from the CDC pertained to strategies focused on increased communication over the duration of the QI-study [17]. Monthly emails containing CDC influenza surveillance reports (e.g. https://www.cdc.gov/flu/weekly/index.htm) were sent to staff. These emails contained influenza like illness (ILI) activity and geographic spread maps to provide a visual representation of regional influenza rates. The images were also accompanied by a note from the study team reminding staff that free vaccination was available through our health center.

Study of interventions and measures

The study utilized the model for improvement, consisting of Plan-Do-Study-Act (PDSA) cycles [18]. Each influenza season served as a PDSA cycle until the HP 2020 vaccination goal was achieved. The first PDSA cycle started after data analysis from the baseline survey (September 2014). The team developed (the Plan Phase) multimodal interventions (in September 2014) and implemented the interventions (the Do Phase) according to the timelines listed in the preceding section. Upon completion of the 2014–15 influenza season, a post-intervention survey was administered (May 2015). The post-intervention survey contained items on vaccination status (i.e. % of respondents vaccinated overall and by department), demographics, and questions that addressed barriers and knowledge of influenza vaccination. We also included three items that assessed staff’s satisfaction with the QI strategies using a five-point Likert scale, with 1 being very dissatisfied and 5 being very satisfied.

The improvement team examined post-intervention data from June to July 2015 (the Study Phase). The interventions were leading the health center closer to the HP 2020 target (90% vaccination), and staff showed high levels of satisfaction with the QI strategies. Because the interventions were effective in the first PDSA cycle, the team replicated them in a second PDSA cycle (2015–16 influenza season). The post-intervention survey indicated that one department which consisted of staff mainly from the allied health professions were furthest from the performance goal (i.e. 71% vaccination rate; n = 14), and were preventing overall vaccination rates from achieving the HP 2020 target. The main barrier identified among these unvaccinated HCP was low perceived risk (i.e. n = 4 out of 14; 28.6%) of acquiring influenza infection (i.e. I rarely get sick from influenza). Therefore, the team met with these HCP to provide additional education and outreach regarding influenza transmission and risk along with the importance of vaccination to prevent its spread to staff and patients, alike.

Upon completion of the second PDSA cycle, a second post-intervention survey was implemented (May 2016), which included items from the first post-intervention survey except satisfaction with interventions. The health center had achieved the performance goal and no further PDSA cycles were undertaken. Therefore, the team replicated all of the interventions, and engaged in quality control/assurance by measuring vaccination uptake with just five survey items in May 2017 (for the 2016–17 influenza season), and again in May 2018 (for the 2017–18 influenza season).

Analysis of the interventions

The main outcome variable/measure within this QI-study was the percentage of survey respondents (i.e. HCP) vaccinated for influenza each season. The analyses were limited to the post–pre-intervention surveys taken across the two PDSA cycles (the 2014–16 influenza seasons). The 2016–17 and 2017–18 influenza seasons were not PDSA cycles, and because the surveys had only five questions to reflect quality control/assurance, these data were not included within the main outcome analyses. The overall percentage of staff who were vaccinated during the quality control/assurance influenza seasons were reported to provide evidence that outcomes were sustainable. CDC influenza vaccination coverage rates for adults 18+ and among all HCP within the USA were both reported as benchmarks to determine the effectiveness of the QI-interventions on the main outcome variable.

The percentage of eligible staff members vaccinated for influenza each season was used as a secondary outcome variable within this QI-study to perform an intention to treat analysis. The denominator used within the intention to treat analysis was adjusted/modified to account for staff excluded because of medical contraindications/religious exemption (n = 3), and known annual staff turnover rates within our healthcare facility. Therefore, we included the sample size from our highest survey (i.e. the 2017–18 influenza season; n = 104) to serve as our denominator within the intention to treat analysis.

Changes in perceived barriers toward influenza vaccination over the two PDSA cycles were also analyzed. Descriptive statistics were used to assess satisfaction with the interventions during the first PDSA cycle. Chi-square statistic for the analysis of all frequency data were used when applicable.

Ethical considerations

Consultation with the University IRB determined that this QI-study was exempt from its formal review procedures. Of note, QI efforts used the Standards for Quality Improvement Reporting Excellence 2.0 (SQUIRE 2.0) guidelines framework [19].

Results

The QI interventions significantly increased overall vaccination coverage from 70.2% at baseline (2011–12 = 69.9%, 2012–13 = 70.9% and 2013–14 = 69.9%; n = 102 respondents) to 84.9% in PDSA 1 (n = 93 respondents), and 91.1% in PDSA 2 (n = 90 respondents), χ² = 309.53, P < 0.001. As shown in Table 1, vaccination rates remained stable and just above the 90% HP 2020 performance
goal during the quality control/assurance measuring periods for the 2016–17 (90.4%; n = 104 respondents) and 2017–18 influenza seasons (90.2%; n = 102 respondents). Vaccination rates within our healthcare facility was well above CDC coverage rates for all individuals (18+) and among all HCP in the USA (see Table 1).

The intention to treat analysis revealed that influenza vaccination coverage did increase over the course of the QI-study (i.e. the 2014–18 influenza seasons) relative to the baseline (the 2011–14 influenza seasons) period (see Table 1). Chi-square likelihood statistic indicated that staff were significantly more likely to receive influenza vaccination over the study period (i.e. the 2014–18 influenza seasons) relative to when no interventions were introduced during the baseline measuring period (i.e. 2011–14), $\chi^2 (1) = 6.83, P = 0.009$. As shown in Table 1, vaccination rates achieved the 90% HP 2020 performance goal during the 2016–17 (i.e. 90.4%) influenza season, and was just below the HP 2020 performance threshold in the 2017–18 (i.e. 88.5%) influenza season. Vaccination coverage was also well above CDC benchmarks for these same time periods within the healthcare facility (see Table 1).

Table 2 shows that, with the exception of one category (i.e. not specified-other), positive shifts were observed in all of the perceived vaccination barriers relative to baseline. Concerns over getting sick or developing side-effects from the influenza vaccine was the most frequently reported (baseline = 13.72%; n = 14 out of 102 respondents) barrier at baseline (see Table 1). In addition, it was the only barrier to show a marked decline on the post-intervention survey’s (PDSA 1 = 3.23%; n = 3 out of 93 respondents; and PDSA 2 = 4.44%; n = 4 out of 90 respondents), $\chi^2 [2] = 10.57, P < 0.01$.

Staff were asked to use a five-point Likert scale to rate their satisfaction with our QI-strategies. Overall, the average satisfaction rating (respondents that gave a score of 4 or 5) across all strategies was 87.3% (n = 92). The accessibility strategies produced the highest levels of satisfaction (92.39%), followed by our communication (88.05%) and education/outreach (81.52%) efforts. Observed differences on staff satisfaction ratings for the three QI-strategies was not statistically significant, $\chi^2 [2] = 0.52, P = 0.77$.

## Discussion

The goal of this improvement study was to achieve the HP 2020 objective of a 90% vaccination rate without having to impose a mandatory influenza vaccination policy. Using three multifaceted strategies to address identified vaccination barriers (see Table 2), this study not only achieved, but sustained the HP 2020 objective (see Table 1). Fear of vaccination side-effects, needles and low perceived risk for influenza infection were barriers which proved modifiable through select QI-interventions [17, 20, 21].

Concerns over getting sick or developing side-effects were the greatest barrier toward vaccination at baseline (see Table 2). Previous literature reported a higher acceptance of influenza vaccination among HCP when they perceived it to be safe and effective [21]. However, providing educational materials alone has not been an effective strategy in shaping the perception of safety or increasing vaccination status among HCP [20, 21].

The current QI-study differs from previous literature by combining educational information (i.e. flu-fact sheet) with direct outreach to HCP. Several in-service sessions were conducted, providing the study team with the opportunity to educate staff directly. These ‘face-to-face’ encounters allowed staff to ask questions regarding their personal concerns over vaccine safety and effectiveness. It is likely that the simultaneous use of education and outreach were drivers of change: significant shifts on the ‘fear of getting sick or developing side-effects’ barrier were observed (see Table 2), and improved overall influenza vaccination rates were attained within the first PDSA cycle (see Table 1). Providing education through ‘face-to-face’ encounters allowed the study team to dispel any misconceptions that HCP might have been harboring about the safety and effectiveness of the influenza vaccine [21]. Therefore, education delivered effectively, and in conjunction with direct encounters and outreach with staff, increases the likelihood of vaccination compliance.

Although significant gains were made after the first PDSA cycle, the current study required improvement by approximately 5% to achieve the HP 2020 objective. Leveraging data from the first pre-intervention survey, additional sources of variance were identified. A lower perceived risk of infection (i.e. 28.6% [4 out of 14] reported I don’t get vaccinated because rarely get sick with influenza) was observed, and an unsatisfactory vaccination rate (i.e. 71%; 10 out of 14 vaccinated) within a unit that consisted mainly of allied health professionals. These findings support the observation that HCP sometimes make decisions to get immunized based on their perceived risk of getting ill contrary to evidence-based information [21, 22]. For this reason, targeted education/outreach was an effective intervention because it delivered an unmet need for scientific information among a subgroup that did not understand their role in acquiring or transmitting influenza infection while at work [17]. Within the second PDSA cycle, perceived risk was no longer a vaccination barrier among these HCP (100% vaccination; n = 14). This study supports previous research noting the importance of focusing interventions on specific sub-groups (e.g. allied health professionals) and context specific variables (e.g. perceived risk) to ensure broader vaccine coverage across healthcare settings [21].

While education/outreach interventions were effective drivers of vaccination uptake, the inclusion of ‘accessible’ immunizations likely contributed to the current study achieving its performance objective. When free, non-invasive vaccinations were provided via nasal spray delivery in the first PDSA cycle, fear of needles was no longer a vaccination barrier (see Table 2). In addition, providing free influenza vaccinations to HCP working night shifts and off-site, as well as making vaccinations accessible at our annual influenza clinic and health center during the influenza season helped increase coverage. Collectively, these multifaceted accessibility strategies produced the highest satisfaction ratings (92.39%) within the current QI-study.

### Table 2 Barriers to influenza vaccination in healthcare personal

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Baseline % (n)</th>
<th>PDSA 1 % (n)</th>
<th>PDSA 2 % (n)</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquiring disease/side-effects from vaccine</td>
<td>13.72% (14)</td>
<td>3.23% (3)</td>
<td>4.44% (4)</td>
<td>$\chi^2 (2) = 10.57, P &lt; 0.01$</td>
</tr>
<tr>
<td>‘rarely get sick from influenza’ (perceived risk)</td>
<td>5.88% (6)</td>
<td>2.15% (2)</td>
<td>0.00% (0)</td>
<td>$\chi^2 (1) = 2.00, P = 0.16$</td>
</tr>
<tr>
<td>Religious or philosophical reasons</td>
<td>5.88% (6)</td>
<td>3.23% (3)</td>
<td>3.33% (3)</td>
<td>$\chi^2 (2) = 2.46, P = 0.29$</td>
</tr>
<tr>
<td>Afraid/dislike needles</td>
<td>1.96% (2)</td>
<td>0.00% (0)</td>
<td>0.00% (0)</td>
<td>$\chi^2 (2) = 3.00, P = 0.22$</td>
</tr>
<tr>
<td>Other or no reason specified</td>
<td>1.96% (2)</td>
<td>4.30% (4)</td>
<td>4.44% (4)</td>
<td>$\chi^2 (2) = 0.80, P = 0.62$</td>
</tr>
</tbody>
</table>
and align well with CDC recommendations that providing free influenza vaccines in locations and at times that are easily accessible may drive vaccination acceptance among HCP [17].

Frequent communication of CDC regional influenza surveillance reports were also included as a QI intervention. The impact of this intervention is unclear, but HCP reported being highly satisfied (88% of staff reported a score of 4 or 5) with receiving these monthly communications. Previous research has shown that electronic media campaigns, especially those that are visual can be effective drivers of vaccination uptake in non-HCP [23]. The ILI activity and geographic maps frequently utilized within the current QI-study were visual representations, and derived from the CDC. It may be essential to further investigate the impact of various media/communication channels when trying to influence vaccination behavior among HCP.

Although typically utilized within randomized controlled trials, we performed an intention to treat analysis within the current QI-study to decrease the probability of a type I error when interpreting our vaccination coverage data. These analyses indicated that vaccination coverage significantly increased over time within our healthcare facility, $\Delta \gamma$ (1) = 6.83, $P = 0.009$. Moreover, vaccination coverage achieved CDC benchmarks within the second PDSA cycle (i.e. the 2015–16 influenza season), and continued to trend upward when the interventions were replicated during the quality assurance periods (i.e. the 2016–18 influenza seasons; see Table 1). However, the CDC national data on influenza vaccination coverage remained stable, and below 80% during the quality assurance periods with the current QI-study (see Table 1). Despite using the more statistically conservative intention to treat analysis, the QI-study was also able to achieve the 90% HP 2020 performance goal during the first quality assurance measuring period (2016–17 = 90%). The results were sustainable because our healthcare facility was just below the HP 2020 performance goal within the second PDSA cycle (i.e. the 2016–17 influenza season), and continued to trend upward when the interventions were replicated during the quality assurance periods (i.e. 2017–18 = 88.5% vaccination coverage). Taken together, the QI interventions within the current study were responsible for the increased vaccination rates within our organization, and the results were not simply part of an ongoing national trend toward increased influenza vaccination coverage.

The limitations of the current study’s improvement work include the fact that data were collected using self-report rather than vaccination records to determine our staff’s annual influenza vaccination status. Previous research has shown that self-reported influenza coverage is a good proxy of vaccination status [24], but can sometimes overestimate coverage when compared to calculations made from vaccination records [25]. Measuring vaccination status through employee/occupational health records could limit any potential biases associated with self-report methods. However, our healthcare facility does not mandate influenza vaccination among its staff or require them to sign declination forms. It is also important to note that there were no other policy changes related to vaccination within our organization such as providing incentives and/or recognition for influenza vaccination. Moreover, participation in this QI-study and its surveys were both voluntary, and anonymous. Therefore, it is unlikely that the self-report method used within this study would have biased staff misreporting their vaccination status due to concerns over institutional policies or mandates regarding influenza vaccination.

Another potential limitation in our QI-study was the response rate on the post-intervention surveys. Initially, the current study had a 93% response rate at baseline (102 respondents out of 110 employees surveyed). The response rate declined to 85% within the first PDSA cycle and 82% during the second PDSA cycle. Because of the declining response rate within the post-intervention surveys, it is possible that our influenza vaccination rate was influenced by sampling bias due to attrition, and that the 90% performance goal was not achieved in the current study. However, when a shorter five-item survey was used during the quality control/assurance periods the response rate returned to baseline levels (2016–17 = 95% response rate [104 respondents out of 110 employees] and 2017–18 = 93% response rate [102 out of 110 employees]). Most importantly, HCP vaccination rates remained at the performance goal during the quality control/assurance periods (see Table 1), indicating findings were statistically valid throughout the QI-study. One plausible explanation for the declining response rate during the current QI-study was measurement fatigue rather than a change in vaccination status among the HCP. The baseline and two post-intervention survey’s contained significantly more items (i.e. an average of 24 items across the three surveys) relative to the five-item survey used in the quality control/assurance periods, $\chi^2 (1) = 12.45$, $P < 0.001$. Therefore, it is essential to consider survey length when using self-report methods to gather information during QI campaigns.

Conclusions

Influenza vaccination coverage among HCP has improved over the past six flu seasons [26], but rates have remained below the national HP 2020 target of 90% [26, 27]. As far as we know, this study is the first to achieve and sustain the 90% performance goal [1, 6] over several influenza seasons. The results of the current study were not influenced by a mandatory influenza vaccination policy or required exemptions by staff even though mandatory vaccination programs can be successful, require less work and are often required within inpatient/hospital settings [7, 8]. There were also no external factors such as the 2009 H1N1 influenza pandemic that could have influenced our vaccination campaign [20, 21]. Finally, given that the foundation of this study’s improvement work involved changing the culture of safety through multifaceted, evidenced-based strategies [17], it’s likely this study’s results are generalizable to other healthcare settings.

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