Perceptions About The New Pertussis Immunization Recommendation Among Health Care Workers

By

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Abstract:

New guidelines from the Advisory Committee on Immunization Practices (ACIP) and the Healthcare Infection Control Practices Advisory Committee (HICPAC) recommend that health-care personnel should receive a single dose of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine (Tdap) as soon as feasible, if they have not previously received Tdap. This represents a change in previous bordetella Pertussis (Pertussis) immunization practices, which previously recommended completion of only a series of Pertussis vaccination during childhood. The ACIP's new policy is largely in response to an increasing in reported incidence of Pertussis within the United States over the past couple of decades and data suggesting that immunity to Pertussis wanes over time. This Master's Paper reviews the health care community's historical response to recommended vaccines and evaluates health care workers' perception of the new pertussis vaccination recommendation in one large University-based Hospital System.

The literature review reveals that misperceptions about vaccines (such as vaccines cause infections or are not effective), individual barriers (such as high cost and inconvenience) and systematic obstacles (such as lack of vaccination policy and incomplete tracking of immunization) make it difficult to achieve high

immunization rates across a wide variety of recommended vaccines. However, none of the studies included in the systematic review discussed the new Tdap vaccine. Our study of health care worker peceptions of the Tdap recommendation is the first published report on the topic. Results from our study indicate that health care workers feel the pertussis vaccine is very important to the health of the public and that health care workers strongly agree that vaccination will prevent them from getting pertussis or giving pertussis to patients. Health care workers agree that Tdap vaccination is a personal responsibility and they also feel that Tdap vaccination should be required for persons who work at a hospital. Both free vaccines and workman's compensation, to cover complications of vaccination, are very important to HCWs. This willingness of health care workers to accept the new vaccine requirement is very different from the resistance healthcare workers have applied to other immunization recommendations as reported in the published literature. UNC Health Care System's Tdap vaccination requirement is an appropriate health care policy and other health care facilities should strongly consider similar Tdap vaccination mandates.

I. Background:

For over 60 years, universal childhood vaccination against *Bordetella Pertussis (Pertussis)* has been recommended within the United States[1]. Since the vaccination campaign began, there has been a tremendous decrease in the incidence of *Pertussis* morbidity and mortality within the United States[2]. However, after reaching an all-time low of 1,010 in 1976, the incidence of reported Pertussis cases have steadily risen, especially in the adolescent and adult population[2],[3]. In 2005, a total of 25,616 cases of pertussis were reported in the United States[4]. Some studies estimate the annual incidence of pertussis in the United States to be in the range of 800,000 to 3.3 million cases per year [5].

This growing incidence of pertussis is likely due to several factors. Studies of serologic antibody titers and U.S. population surveys suggest that immunization rates have been declining[6, 7], leaving many people at risk for pertussis infection. In addition, studies indicate that immunization with childhood vaccination series wanes over time[8, 9], resulting in fully vaccinated individuals becoming more susceptible to pertussis as they age. This combination of increasing rates of non-immunization, increasing rates of incompletely immunized and waning immunity has reduced the population's ability to provide heard immunity. A lack of herd immunity places us all at increased risk of pertussis infection.

As a result of these factors, new Advisory Committee on Immunization Practices (ACIP) guidelines recommend that adults aged 19–64 years should receive a single dose of Tdap instead of tetanus and diphtheria toxoids vaccine (Td) for booster immunization against tetanus, diphtheria, and pertussis.[2] Patients may be excluded from the recommendation if they received their last dose of Td <10 years earlier or they have previously received Tdap.[2] However, health-care personnel who work in hospitals or ambulatory care settings and have direct patient contact should receive a single dose of Tdap as soon as feasible if they have not previously received Tdap.[2]

At UNC Hospitals as of 2006, all new employees at UNC will be required to receive the new Tdap vaccine at the start of employment. In addition, all current employees will be required to receive the vaccination by the end of 2008. However, little is know about how health care workers will respond to the new pertussis vaccination campaign. Although the efficacy and need for pertussis vaccination in the health care environment is generally agreed upon, understanding how employees perceive this new requirement may identify barriers to successful hospital vaccination campaigns, identify ways to enhance employee satisfaction and serve as a proxy for general population perceptions.

Previously published articles illustrate difficulties in achieving high levels of recommended immunization coverage. Published surveys give us the opportunity to explore the beliefs and feelings of participants. Results of investigative trials

give us evidence that that these individual perceptions about vaccines may be barriers to immunization. Finally, reported program evaluations demonstrate that systematic barriers also affect our ability to achieve high levels of immunizations.

Numerous surveys show that the public perceptions of vaccines vary substantially. For example, Heininger used an internet-based survey of mostly German participants to investigate parental perception of childhood vaccination.[10] He found many respondents felt that vaccines are given at too early an age, are concerned about overloading of the immune system and felt that induction of allergies could be a side effect of recommended immunization.[10] The respondents in the survey also believed that certain vaccines included in the hexavalent combination vaccine (tetanus, diphtheria, pertussis, poliomyelitis, Hib and hepatitis B vaccines) were considered to be more important than vaccines that are not in the hexavalent combination such as the MMR, varicella and influenza vaccines.[10] Szucs et al, also surveyed European beliefs about immunization.[11] In their telephone based survey of 5 European countries, they found reasons for not being immunized with influenza vaccine included "I don't think I am very likely to catch influenza", "I have never considered it before", "my family doctor has never recommended it to me", "I am too young to be vaccinated", "it is not a serious enough illness", and "I thought about it but I didn't end up having the vaccination".[11]

Studies about the link between individual barriers to vaccination are described through out the literature. Hofmann et al conducted a systematic review of published influenza vaccination campaigns to see if certain methods correlated with increased vaccination rates.[12] They found that the most successful vaccination campaigns addressed the individual barriers of lack of awareness, lack of education and lack of convenience.[12] However, the authors note that even though a program may address these issues, it does not guarantee success in every instance.[12] Another study, which correlates various individual barriers with immunization rates, was Jones et al.[13] The authors used a telephone survey to evaluate the determinants of vaccination receipt among Tennessee residents.[13] The participants reported that the barrier to immunization include lack of awareness ("thought vaccination unnecessary" or "never thought about it"), lack of education ("believed vaccination would cause illness" or "side effects not worth it"), and lack of convenience ("no time" or "never saw provider to ask").[13] Additionally, many non-immunized respondents cited additional barriers of cost and unavailability.[13]

Systematic barriers that affect immunization rates are an important aspect to understand when addressing low immunization rates as well. Irigoyen et al examined whether follow-up reminders would boost immunization rates.[14] She found that these immunization registries were not effective, mostly due to the systematic barriers of incomplete immunization data (leading to children receiving false reminders), inaccurate patient contact information (leading to

children being unable to be reached), and provider missed opportunities (leading to children not receiving vaccine dose at appointment).[14] Another example can be found in the article by Wirsing et al which describes the Global Pertussis Initiative.[15] Like the United State, Europe has seen a shift in the incidence of Pertussis from infants and toddlers to school age children and adolescents, in addition to an increase in the incidence of disease among infants, over the last decade.[15] As a result several European countries have sought to control pertussis infections and prevent morbidity and mortality in infants through the formation of the Global Pertussis Initiative.[15] They found that systematic barriers, such as lack of standardized diagnostic criteria and poor access to laboratory confirmation of the diagnosis, contribute to the wide spread infections.[15]

These examples of barriers to immunization lead us to believe that any new recommendation for immunization , such as the new Tdap recommendation, will have equal difficulty achieving target levels of coverage. A complete systematic review of the barriers to immunization among health care workers would be appropriate to accurately assess the published literature.

To address the potential barriers to the Tdap immunization recommendation, this Master's paper describes a complete systematic review of the literature regarding health care workers' barriers to immunization and describes the methods, analysis and results of a study designed to quantitatively and qualitively evaluate employee perceptions of the new pertussis vaccination requirement. Finally, the

conclusion will incorporate findings from both the systematic review and health care worker questionnaire into a comprehensive product.

II. Systematic review:

Overview:

As mentioned above, a systematic review is the most complete way to asses the published literature. I conducted a systematic review to gain a population based understanding about the barriers (individual beliefs and systematic problems) to health care workers' immunization.

Methods for literature review:

To identify articles for inclusion, I searched the Pubmed searchable database. I searched Pubmed from 1966 to December 31, 2006 and limited my search to English and humans, with the terms"(barrier OR barriers) AND (immunization OR vaccine) AND health personnel". I included articles containing original data describing health care worker reported factors, which are associated with acceptance or non-acceptance of vaccines. I was only interested in those vaccines currently recommended for health care workers within the United States. One-hundred and ten articles were returned.

The abstracts of these articles were then reviewed for exclusion criteria related to the search strategy above. The exclusion criteria were as follows: articles which did not contain primary data (e.g. guideline/reviews/editorials/letters), articles which did not contain information from U.S. populations (e.g. foreign populations), articles which did not relate to attitudes, beliefs or barriers of

immunization or vaccination (e.g. clinical trials outcomes or non-vaccine related research), articles which did not contain information about one of the nine ACIP recommended vaccines for health care workers (i.e. influenza, hepatitis B, mumps, measles, rubella, diphtheria, tetanus, pertussis, and varicella), articles which did not obtain information from health care workers (e.g. survey of non-health care worker), or articles which do not discuss self-vaccination (e.g. physician perception of patient vaccination). When the inclusion/exclusion criteria were unclear from the abstract, the articles methods section was reviewed for further detail. Further explanation of the rationale is described below.

Rationale for Inclusion and Exclusion of Articles:

Since the primary focus of this survey and search is directed at the perceptions and belief of health care workers within the United States, it was felt that this systematic review should be limited to data collected from U.S. health care workers. While this excludes data obtained from foreign countries, it does not necessarily exclude all articles with data collected from foreign countries. Those articles describing foreign data, which also referred to perceptions within the United States were included (i.e. articles were excluded if they did not discuss some of the barriers with in the United States, but were included if they did discuss some of the barriers within the United States).

One could argue that international barriers to immunization is an important perspective to understand when implementing a vaccination campaign, especially

since populations of the world are rapidly globalizing and communicable diseases don't obey political boundaries. However, it was felt that international concerns about health care vaccinations were too broad of a topic to cover in this master's paper. Personal beliefs and national health care systems vary substantially between international countries. For instance, populations in the United States and the United Kingdom fear an association between the MMR vaccine and autism, while populations in France fear an association between the Hepatitis B vaccine and demyelinating disease.[10]

The ideal systematic review would be only interested in health care workers perceptions of the combined Tdap adult vaccine. However, Adult pertussis immunization for health care workers is a relatively recent recommendation and no studies describing health care workers beliefs or attitudes toward the new recommendation were found during the literature review. Therefore, a broader literature search was needed in order to obtain some baseline guidance from the literature.

One could argue that considering all populations with in the United State deserve consideration when surveying peoples attitudes regarding vaccination. However, it was felt that the health care workers consist of a unique demographic, which do not necessarily share the same beliefs as other populations. They are generally working age adults (18-65) and have high level exposure to communicable diseases on a regular basis.

The barriers to childhood immunization are interesting to study because there is a similar effort to achieve 100% coverage. While valuable insight can often be obtained by examining populations under 18, it was felt that the motivation for childhood vaccination is much different than adults. For example a major driving factor in childhood immunization is the mandate to be vaccinated before one can attend school. Adults don't have an equivalent vaccination motivation. In addition, most adults that work in the health care environment are competent and make their own decisions. Children, on the other hand, are bound by the decisions that their guardian makes. Thus, an examination of barriers to childhood vaccination might more accurately reflect the barriers that guardians of children face. Therefore, the target population for this literature review can be rationally limited to adults.

Adult vaccination campaigns are interesting to study as well, but none of them have any mandated vaccination similar to the hospital environment. In addition, health care workers often have a duty to protect their patients as a term of employment, unlike these voluntary vaccinations of the general adult population. Thus, examining motivation and barriers to achieving high levels of adult vaccination in the community setting is not appropriate for this study. Thus, studies for this literature review will be limited to interventions and perceptions of adult health care workers.

There are numerous vaccines available and each has its own side-effect profile, cost and benefit associated with each vaccine. We can reasonably believe that the risk and benefits of immunization may be similar across FDA recommended vaccines for many vaccine preventable diseases in adults. Thus, examining the literature pertaining to barriers to immunization of diseases other than pertussis may reveal valuable information. However, articles describing vaccines that are not approved by the FDA were excluded as they are generally experimental and not believed to be applicable to this discussion because they may be dangerous or have an unproven track record.

This systematic review was limited to surveys which pertained to vaccines currently recommended by the ACIP for health care workers. According to the ACIP website "The Advisory Committee on Immunization Practices (ACIP) consists of 15 experts in fields associated with immunization who have been selected by the Secretary of the U. S. Department of Health and Human Services to provide advice and guidance to the Secretary, the Assistant Secretary for Health, and the Centers for Disease Control and Prevention (CDC) on the most effective means to prevent vaccine-preventable diseases."[16] They are a well respected organization which meets on a regular basis to discuss the risks and benefits of vaccination. It was felt that this expert panel would be able to select the most appropriate vaccines for health care workers to use. Thus, articles discussing these nine vaccines would be important to include in review.

Vaccines that were not part of the recommended vaccines for health care workers were not included in the systematic review. It was felt that these non-included vaccines probably held unique risks of vaccination, poor effectiveness, or low risk of infection within the health care worker population. For instance, vaccines such as yellow fever, small pox or even HPV, may elicit different beliefs and perceptions among health care workers than the general population. Therefore, articles that discussed non-ACIP recommended vaccines were excluded from analysis.

Lastly, articles that did not discuss perceptions of immunization or barriers to immunization were excluded because they are not applicable to our interest.

Results of literature review:

Of the one-hundred and ten identified articles, eight met our criteria for inclusion (See table below). The studies that were excluded can be generalized into the following groups: Not primary data (19), not containing U.S. data (28), not related to perceptions of vaccination (9), not pertaining to one of the nine recommended ACIP vaccinations for health care workers (7), and not surveying health care workers or not surveying health care workers about self-immunization (39). Some studies fell into multiple groups, but further analysis of excluded studies was not pursued.

Of the eight articles included for review, none of the studies discussed the perceptions of health care workers regarding the new Tdap vaccination. However, the articles found did describe health care workers' perceptions of influenza, hepatitis B and varicella vaccination among a broad range of health care occupations including: physicians, nurses, residents, students, emergency medical technicians, paramedics, and dental health care workers.

Title	Study Design	HCW group Studied	ACIP Vaccine Studied
Goldstein et al. Increasing Influenza Immunizations Among HCWs. 2004	Cross-sectional survey. Method: telephone survey (non-anonymous)	Infection control individual (or the most knowledgeable person) of health care facilities with in N.C.	Influenza
Nichol et al. Influenza vaccination of health care workers. 1997	Cross-sectional survey. Method: mailed survey (anonymous)	Health Care Workers at a single large University-affiliated Veteran's Affairs medical center	Influenza
Weingarten et al. Barriers to influenza vaccine acceptance: a survey of physicians and nurses. 1989	Cross-sectional survey. Method: mailed survey (non-anonymous)	Health Care Workers at a single large teaching hospital	Influenza
Toy et al. Influenza immunization of medical residents: knowledge, attitudes and behaviors.2005	Cross-sectional survey. Method: paper based survey (anonymous) collected at same meeting	Resident Physicians at single large urban teaching hospital	Influenza
Martinello et al. Correlation between health care workers' knowledge of influenza vaccine and vaccine receipt. 2003	Cross-sectional survey. Method: paper based survey (non-anonymous)	Health Care Workers at a large urban teaching hospital	Influenza
Lee et al. epidemiology of hepatitis b vaccine acceptance among urban paramedics and emergency medical technicians.1997	Cross-sectional survey. Method: mailed survey (anonymous)	Paramedics and Emergency Medical Technicians in a single large urban fire rescue department	Hepatitis B
Jacobson et al. Acceptance of Hepatitis B vaccine among dental health care workers. 1989	Cross-sectional survey. Method: mailed survey (anonymous)	Dental Health Care Workers at a single large dental school	Hepatitis B

Queresh et al. Controlling varicella in health care setting: barriers to varicella vaccination among health care workers.1999	Cross-sectional survey. Method: telephone survey (non-anonymous)	Health Care Workers undergoing pre-employment evaluation at a single large medical system	Varicella

Critical Appraisal Methods:

Each survey was given a quality rating based on its potential for selection bias (e.g. how the study population compared to the target population), measurement bias (e.g. whether barrier questions and immunization measures were valid and reliable), and confounding (for predictive studies only) as evidenced by the methods section of each article. The overall assessment categories are Good (well designed study with conclusions that can be applied to intended population), Fair (study does not have many major flaws with conclusions that should be interpreted with caution); Poor (study has several major flaws with conclusions that should be considered invalid).

Critical Appraisal Results:

In addition, each articles' reported barriers to immunization is summarized in the table below. A more extensive description of each article's limitations can be found in appendix A.

Title	Goldstein et al. 2004	Nichol et al. 1997	Weingarten et al. 1989	Toy et al. 2005	Martinello et al. 2003	Lee et al. 1997	Jacobson et al. 1989	Queresh et al. 1999
Overall Assessment*	Good quality	Good quality	Good quality	Fair quality	Fair quality	Fair quality	Poor quality	Fair quality
Total Participants	268	392	193	43	212	255	586	70

*See appendix A for more details;

Influenza Immunization:

Five studies examined Influenza vaccination, which probably has the most similar risks and benefits to adult pertussis vaccination. Of these, 1 study was predictive and 4 were descriptive.

The article by Goldstein et al is a good quality survey of infection control individuals at various institutions about their perceptions of Influenza vaccine (See critical appraisal of Goldstein for more details). Goldstien et al focuses on the institutional policies and practices of influenza immunization, which ultimately effect our perceptions of immunization.[17] They conducted a telephone survey of a sample of health care institutions across the state of North Carolina. 312 institutions were selected out of a possible 1316 institutions and 268 (86%) of them participated in the study.[17] The quality of the study is good with only minor limitations, so we can have reasonable confidence that the results are accurate.

The article by Nichol et al is a good quality survey of Health Care Workers at a large University-affiliated Veteran's Affairs medical center about their perceptions of the influenza vaccine (See critical appraisal of Nichol for more details). 1031 physicians and nurses were mailed surveys and 392 (38%) were returned.[18] The quality of the study is good with only minor limitations, so we can have reasonable confidence that the results are accurate.

While some may consider 38% response rate to be a serious or even fatal flaw, it is common knowledge that response rates of 5-30% are very common in survey research[19, 20]. In order for a low response rate to affect the validity of the study, the non-respondents must differ from the respondents. I have no reason to suspect that volunteer bias may affect the results one way or another. Although a higher response rate is preferable, a response rate of 38% is not a serious or fatal flaw because we are only interested in determining what barriers to immunization rate have been reported in the literature and this survey has a high total response rate of 392 persons.

The article by Weingarten et al is a good quality survey of Health Care Workers at a large teaching hospital about their perceptions of the influenza vaccine (See critical appraisal of Weingarten for more details).[21] 463 nursing personnel and physicians were mailed surveys and 193 (42%) were returned.[21] The quality of the study is good with only minor limitations, so we can have reasonable confidence that the results are accurate. As stated above, 42% response rate is not a serious or fatal flaw.

The article by Toy et al is a fair quality survey of Resident Physicians at single large urban teaching hospital about their perceptions of the influenza vaccine (See critical appraisal of Toy for more details).[22] All 43 residents were surveyed and 43 (100%) were returned.[22] Since this article has a couple concerning methodologic problems, we should interpret the authors conclusions with caution.

One limitation is the very small subgroup used to assess the barriers to non-vaccination (18 subjects non-vaccinated). It is possible that this article is not appropriately powered to accurately assess the articles intended goal of determining the barriers to acceptance of influenza immunization among medical residents. In addition, the 100% response rate and the administration of the survey in the environment of a resident meeting may limit the validity of the survey. The participants may have felt obligated to participate and may be motivated to provide answers that present themselves or the department in a favorable light.

The article by Martinello et al is fair quality survey of Health Care Workers at a large urban teaching hospital about their perceptions of the influenza vaccine (See critical appraisal of Martinello for more details).[23] 215 nursing and physician were surveyed and 212 (99%) surveys were returned.[23] Since this article has a couple concerning methodologic problems, we should interpret the authors conclusions with caution. For instance, it is not stated whether the authors intended to analyze the data as aggregate groupings of "nurses" and "physicians" or if they retrospectively adjusted the analysis to find statistical significance. Additionally, the very high response rate of 99% is suspicious for high pressure tactics used to increase response rate. If this were the case, the participants may have felt obligated to participate and may be motivated to provide answers that present themselves or the department in a favorable light.

Hepatitis B Immunization:

Studies of other vaccinations are less similar to Tdap than the influenza vaccination, but provide important insights because of their predictive design (n=2), occurrence in sites with existing vaccine policy (n=2), and large sample sizes.

The article by Lee et al is a fair quality survey of medical first responders at a large urban fire rescue department about their perceptions of the hepatitis B vaccine (See critical appraisal of Lee for more details).[24] All 1250 paramedics and emergency medical technicians were included in the mailed survey and 296 (24%) were returned.[24] Since this article has a couple concerning methodologic problems, we should interpret the authors conclusions with caution. For example, the article grouped the 11 respondents who have had hepatitis B and declined immunization as participants who have not been vaccinated. These 11 people may have acquired immunity or be living with hepatitis B. In either case, their views may be very different from the views of other participant without hepatitis B experience and choose to decline immunization. Additionally, the backward logistic regression did not assess history of blood exposure as a predictor of vaccine uptake, even though it was assessed in the questionnaire.

As previously stated above, a low response rate may be considered a serious or even fatal flaw by some. However, it is common knowledge that response rates of 5-30% are very common in survey research[19, 20]. In order for a low response

rate to affect the validity of the study, the non-respondents must differ from the respondents. I have no reason to suspect that volunteer bias may affect the results one way or another. Although a higher response rate is preferable, a response rate of 24% is not a serious or fatal flaw because we are only interested in determining what barriers to immunization rate have been reported in the literature and this survey has a high total response rate of 255 persons.

The article by Jacobson et al is a poor quality survey of dental health care workers at a large dental school about their perceptions of the hepatitis B vaccine (See critical appraisal of Jacobson for more details).[25] Jacobson et al surveyed students, faculty and staff within a single dental school to determine factors influencing the acceptance of hepatitis vaccination after conclusion of a vaccination program.[25] All 976 students, faculty and staff were included in the mailed survey and 586 (60%) were returned.[25]

Upon review of the methods section in the article by Jacobson et al, this study was found to have many serious flaws[25] The analysis and conclusions are particularly troubling. On page 70 in the results section, the article states that data was analyzed with exposure (dependent variable or X) being acceptance/nonacceptance of Hepatitis B. Yet, the conclusions routinely refer to various factors (dependent variable) which are the determinants of Hepatitis acceptance/nonaccpetance (outcome, independent variable or Y). This is not correct and analysis by this backward methodology could seriously affect the

results of the study. Furthermore, simple calculations are incorrectly performed. For example, the vaccine acceptance rate of students is listed in the table as 495 out of 555 = 89.2%. Yet, it is quoted in the results as 93% acceptance. Also, the table states 664 subjects out of 976 total accepted the vaccination (vaccination rate = 68.0%). Yet, the text under methods states that 667 persons out of 979 total accepted the vaccination (vaccination rate = 68.1%). Both of these numbers are than the difference of 68.5% stated in the results section on page 68. If these simple calculations cannot be performed correctly, I am suspicious that none of the calculations are performed correctly and could seriously affect the results of the study. Another problem is that the analyzed data was retrospectively adjusted. On page 68 of the methods section it states, "when expected chi-square frequencies were found to be less than five, categories were collapsed appropriately to increase the number of respondents in a particular group". These retrospective adjustments may seriously affect the results of the study. This may also have occurred in the analysis of "at risk" subjects. The article states that the "at risk" was analyzed as a dichotomous variable, with >2% means yes and <2% means no, even though the table clears shows that there is more than 2 categories are available for analysis. Another analysis mistake is that the authors considered those who may have had previous vaccination or whose vaccination status is unknown as nonacceptance for purposes of analysis. This would mean there is the potential for vaccinated individuals to be in the "nonaccpetance" grouping, which may seriously affect the results of the study.

The study by Jacobson et al also contains selection and measurement bias. During the study, the vaccine campaign was directed at all dental health care workers.[25] Yet, faculty and staff paid $105 for the vaccine and students paid $25 for the vaccine.[25] While this could represent encouragement for students to receive the vaccine, it could also represent an insurmountable financial barrier for low income staff.[25] During the analysis of the study, the authors defined "at risk" to be subjects who spent >2% of their time in patient contact.[25] I believe this is an arbitrary percentage of 2% and I'm not sure how a study subject would determine what percent of time they spent in patient contact.[25] Furthermore, it is probably more appropriate to believe that any exposure to patients would put the dental health care worker at risk for hepatitis B. It is also more appropriate to measure patient contact time as a continuous variable or at lease have categories with equal range (eg <25%, 25-50%, 51-75%, >75%). I believe the methodologic are serious enough to exclude many of the authors' conclusions.

Varicella Immunization:

Only one study examined varicella immunization. It was predictive.

The article by Qureshi et al is a fair quality survey of Health Care Workers undergoing pre-employment evaluation at a large medical system about their perceptions of the varicella vaccine (See critical appraisal of Qureshi for more details).[26] 2801 employees were screened for evidence of VZV anti-bodies.[26] The 90 employees found to be susceptible to the virus were telephoned for

participation in the survey.[26] The authors were able to contact and survey 78% (n=70) of those susceptible.[26] Since this article has a couple concerning methodologic problems, we should interpret the authors conclusions with caution. For instance, almost one quarter were retrospectively excluded because they never received the offer for vaccination. [26] Another 22% of the eligible persons did not agree to participate.[26] In total, only 53 people reported their opinions about receiving the vaccine (38 subjects) or not receiving the vaccine (15 subjects).[26] The very small subgroup used to assess the barriers to non-vaccination (15 subjects non-vaccinated) is a limitation to the study[26]. It is possible that this article is not appropriately powered to accurately assess the articles intended goal of determining the barriers to acceptance of influenza immunization among medical residents.

Findings in Reviewed Articles:

Numerous incentives and barriers to vaccination were discussed within the articles (see table below). Unfortunately, the subjective nature of the surveys, the different formats of the questionnaires and the inconsistent answer options for responses prevent us from directly comparing data. However, substantial trends can be established.

Barriers to Health Care Workers' Immunization:

Title	Commonly reported barriers to immunization (% of respondents)*	Other reported individual barriers to immunization (% of respondents)*

Goldstein et al. 2004	- Fear of needles (26%) - Fear of side effects (68%) - Cost (7%) - Vaccine ineffective (53%)	- "enforcing the policy" (11%) - Lack of written immunization policy (62%) - Lack of immunization requirement (98%)
Nichol et al. 1997	- Fear of needles (5.3%) - Inconvenient (9.9%) - Fear of side effects (36.2%) - Cost (0.7%) - Low risk of infection (14.5%) - Forgot (4.6%)	- "disagree with recommendations" (9.9%) - "do not have contact with high-risk patients" (5.9%)
Weingarten et al. 1989	- Fear of needles (12%) - Inconvenient (31%) - Fear of side effects (29%) - Cost (5%) - Fear of infection from vaccine ▪ Influenza (25%) - Vaccine ineffective (24%)	- "avoid medications whenever possible" (59%) - "prior adverse reaction to the vaccine" (5%) - "allergic to vaccine" (1%)
Toy et al. 2005	- Fear of needles ▪ "do not like needles" (11.1%) ▪ "concern about pain/discomfort" (11.1%) - Fear of side effects (11.1%) - Low risk of infection ▪ "not likely to get flu" (16.7%) ▪ "not in high-risk group" (16.7%) ▪ "flu is not a serious disease" (11.1%) - Vaccine ineffective (11.1%) - Forgot (44%)	- "not interested" (16.7%) - "did not know it was available" (5.6%) - "allergic to the vaccine" (5.6%)
Martinello et al. 2003	- Fear of needles (NR) - Inconvenient (NR) - Fear of infection from vaccine ▪ influenza like illness (NR) - Low risk of infection (NR) - Current pregnancy/breastfeeding (12%) - Forgot (NR)	- Availability of neuraminidase inhibitors (6%)
Lee et al. 1997	- Fear of needles (20%) - Inconvenient ▪ scheduling difficulties (23%) ▪ lack of time to get vaccinated (15%) - Fear of infection from vaccine ▪ Hepatitis (26%) ▪ HIV (11%)	- Previous hepatitis B infection (11%)

Jacobson et al. 1989	- Inconvenient (90%) - Cost (25%) - Fear of infection from vaccine ▪ GBS (4%) ▪ AIDS (4%) - Fear of side effects on pregnancy (46%)	- Unknown side effects (7%) - "too time consuming" (5%)
Queresh et al. 1999	- Inconvenient (20%) - Fear of side effects (26%) - Low risk of infection (33%) - Currently pregnant (20%)	- Lack of knowledge about immunization status (24%) - Lack of offer for free vaccination (24%)

*See appendix B for more details. NR = not reported

Every article included in the systematic review reported individual barriers to receiving immunization. The common barriers to immunization are cited numerous times throughout the articles. They include fear of fear of needles (6), inconvenience (6), side effects (5), cost (4), fear of infection from the vaccine (4), low risk for infection (4), vaccine ineffective (3), currently pregnant/fear of side effect on pregnancy (3), and forgot (3). Other reported barriers to immunization include: "enforcing the policy", unknown side effects, "too time consuming", previous hepatitis B infection, availability of neuraminidase inhibitors, "not interested", "did not know it was available" , "allergic to the vaccine", "disagree with recommendations", "do not have contact with high-risk patients", "avoid medications whenever possible", and "prior adverse reaction to the vaccine". A more thorough description of reported barriers can be found in appendix B.

A couple of articles described some of the systemic barriers that may affect immunization rates. The article by Goldstein et al finds low levels of institutions with written immunization policies (38% of institutions) and lack of influenza immunization mandates (2% of institutions, which have written policies) were

common across the institutions surveyed. The authors also discuss the lack of state-wide regulations creating a barrier to immunization. Another article, by Quershi et al, found that many of the HCWs surveyed (24%) never received notice of their immunization status. Those same HCWs also did not receive the offer for free vaccination.

Incentives for Immunization:

Title	Commonly reported incentives or reasons for immunization*	Other reported incentives or reasons for immunization*
Goldstein et al. 2004	- Reduced cost ▪ Free (69%) ▪ Low cost (32%) - Reminders: annually (88%)	- Educational efforts (52%) - Vaccination drives (13%)
Nichol et al. 1997	- Recommended ▪ By national policy (25%) ▪ By physician (7.9%) - Increased access (68.3%) - Reduced cost (58.3%)	- "not wanting to get sick" (82.5%) - "protecting patients" (61.7%)
Weingarten et al. 1989	- Recommended ▪ By national policy (73%) - Increased access (53%) - Reduced cost (47%)	- "if the vaccine had little risk" (55%)
Toy et al. 2005	- Recommended ▪ By other employees (24%)	- "at risk because of their work" (80%) - "risking transmission to patients" (68%) - "influenza vaccine generally safe" (56%) - "influenza vaccine is effective" (36%) - "flu is a serious disease" (28%) - "has chronic illness" (4%)
Jacobson et al. 1989	- Reminder: scheduled appointment (87%)	- Severity of hepatitis B is great (96%) - Effectiveness of vaccine is high (88%) - Susceptibility to hepatitis is high (66%)

Queresh et al. 1999	- Recommended ▪ By hospital (21%) - Reminder: follow-up to screening titer (NR) and to offers for vaccination (NR)	- Desired immunity (74%) - Wanted to avoid infection in others (24%)

*See appendix B for more details. NR = not reported. None were reported by Lee et al or Martinello et al.

Many articles included in the systematic review reported incentives and reasons for immunization. The common incentives and reasons are recommendations (4), reduced cost (3), reminders (3), and increased access (2). Other reported incentives and reasons for immunization include: educational efforts, vaccination drives, belief that disease is serious, belief that vaccine is effective, belief that vaccine is safe, belief that HCW is at risk of infection, desired immunity, to avoid infection in others, and "has chronic illness". A more thorough description of reported barriers can be found in appendix B.

Factors Independently Associated with Barriers to Immunization, Incentives for Immunization or Vaccination Rate:

Title	Common Demographics' independently association with barriers, incentives or vaccination rate* (p-value)	Other Factors' independently association with vaccination rate*
Goldstein et al.. 2004 - Good Quality - Influenza		**- Instituional category (p<0.001)**

Nichol et al. 1997 - Good Quality - Influenza	**- Age: OR = 1.04 for each increasing year of age** **- Occupation: OR = 2.2** **- Prior vaccination: OR = 5.4** - Sex (NS) - Work Setting (NS) - Frequent contact with seriously ill (NS) - Frequent contact with patients >65 (NS) - Smoking (NS) - Alcohol (NS) - Exercise (NS) - Previous vaccination (NS) - Plan to be vaccinated next year (NS) - Recommend vaccination to high risk patients (NS)	- **Health beliefs** ▪ **Influenza and its complications are very serious for high-risk patients: OR = 4.9** ▪ **Vaccine is very effective: OR = 2.2** ▪ **Vaccination is uncommonly associated with side effects: OR = 2.0** ▪ Healthcare workers' risk for contracting influenza is higher than the general public (NS) ▪ Very important for healthcare workers to receive the vaccine to decrease risk for transmission to high-risk patients (NS)
Weingarten et al. 1989 - Good Quality - Influenza	**- Occupation (p<0.05)**	
Toy et al. .2005 - Fair Quality - Influenza	**- Postgraduate level (p=0.05)** - Age (NS) - Sex (NS) - Type of medical school (NS) - Field of practice (NS)	**- Plan to be vaccinated next year. (p<0.001)** **- Knowledge about vaccines (p=0.02)** **- Media influence (p<0.001)** **- Recommended by other employees (p=0.03)** - Had children under age of 16 years (NS) - Would recommend the vaccine to patients (NS) - Respondents' health status (NS)
Martinello et al. 2003 - Fair Quality - Influenza	**- Occupation (p<0.001)** **- Prior vaccination (p<0.001)** - Age (NS) - Other demographic characteristics (NS)	**- Knowledge about vaccines (p=0.002)**

Lee et al. 1997 - Fair Quality - Hepatitis B	**- Age** ▪ **20-35: OR = 1** ▪ **36-41: OR = 4.14** ▪ **42-46: OR = 5.66** ▪ **47-66: OR = 7.69** **- Occupation** ▪ **Paramedic: OR = 1** ▪ **EMT: OR = 2.77** - Other sociodemographic characterisitics (NS)	**- Seniority (Officer vs non-officer)** ▪ **Non-officer: OR = 1** ▪ **Officer: OR = 0.28** - Compliance with universal precautions (NS) - Disease attitudes (NS) - Other job characteristics (NS)
Jacobson et al. 1989 - Poor Quality - Hepatitis B	**- Age (0.012)** **- Occupation (p<0.030)** - Sex (NS)	**- Reminder: scheduled appointment (0.008)** **- Cost of the vaccine (<0.001)** **- Inconvenient (<0.001)** **- Personal health beliefs** ▪ **Severity of hepatitis B (0.048)** ▪ **Susceptible to hepatitis B (<0.001)** ▪ Vaccine is effective (NS) - Side-effects (NS)
Queresh et al. 1999 - Fair Quality - Varicella	- Age (NS) - Gender (NS) - Race (NS) - Occupation (NS) - Direct patient care (NS)	- Knowledge about VZV (NS) - Attitudes about VZV (NS)

* Significances reported are from final analysis in **bold type**. See appendix B for more details. Goldstein et al and Weingarten et al did not report factors that correlated with vaccination rate. NS = not significant.

Numerous other interesting results were found in the systematic review. These results are interesting because we can see that many of the individual barriers to immunization, incentives for immunization and systematic barriers to immunization are significantly related to factors such as age and occupation. Thus, consideration of how these factors are affected by confounding is important to consider in our analysis. A more thorough description of these results can be found in appendix B.

Limitations

Limitations of this systematic review include single reviewer rated quality, limitation of the search terms used, limitations of searching a single database (pubmed) and publication bias.

Discussion of Systematic Review:

Several themes reappeared throughout my systematic review including: the barriers to vaccination, incentives for vaccination and other factors associated with immunization rates. I'll address these common threads by each topic in these next few pages.

Our findings were similar to others in the literature. According to Weber et al, commonly reported barriers to immunization with influenza and hepatitis B vaccines are desire to avoid medications, inconvenient vaccine administration, concern about side effects, fear of infection caused by vaccine, and belief that vaccine is ineffective, belief that the HCW is at low risk for infection[27]. All of these barriers to immunization are reported in our review of the literature as well. In addition, fear of needles, cost, currently pregnant (or concern about effects on pregnancy), and forgetfulness are commonly reported reasons to decline immunization. However, the desire to avoid medications was only cited by one article. Other barriers are reported infrequently.

These studies (including those reported in our review) are too diverse in terms of populations, time, vaccinations of interest, study design and geography to speculate as to which barriers might be the most commonly reported. They are also too diverse to attempt to compile percentages reported and rank the importance of each as a barrier to immunization.

According to Weber et al, interventions that improve vaccination rates are increased access to vaccination, incentive programs, educational campaigns, and weekly feedback from the staff[27]. All of these incentives for immunization were reported in our review of the literature, except weekly feedback from the staff. However, incentive programs may have different meanings at different institutions and weekly feedback could be considered a reminder from staff. In addition, reduced cost, reminders and recommendations were commonly reported incentives for immunization. Other incentives for immunization are reported infrequently.

Again, these studies are too diverse in terms of populations, time, vaccinations of interest, study design and geography to speculate as to which incentives might be the most commonly reported. They are also too diverse to attempt to compile percentages reported and rank the importance of each as an incentive to immunization.

This systematic review of barriers to immunization gives us some perspective on why many common immunization recommendations don't achieve their intended immunization goals. It also provides some areas to focus on during our study of perceptions of Tdap (such as vaccine effectiveness, cost of vaccination, knowledge of vaccines and vaccine mandates) and gives us some independent predictors (such as age, occupation and previous vaccination) that we should consider when evaluating the perceptions of Tdap.

III. Survey on Pertussis Vaccine Requirement at UNC:

Overview of the survey:

This research plan consisted of creation, distribution and analysis of a cross-sectional questionnaire (appendix C) provided to new employees of the UNC Health Care Systems. The questionnaire evaluated employees' perceptions of the new requirement for pertussis immunization and evaluated for potential confounders. Key areas of interest were employee perceptions of vaccine effectiveness, willingness to receive vaccination as a term of employment, potential barriers to vaccination and current employee knowledge of pertussis. The results of this survey will be submitted to the American Journal of Infection Control for publication.

Methods of the Survey:

The survey was administered to all new employees of the UNC Health Care Systems during the standard 2-day orientation sessions throughout the month of March, 2007. We originally anticipated that we would survey approximately 100-200 employees over the age of 18, including both sexes, all ethnicities or races and all occupations that attended the new employee orientations. There were no diseases or conditions that prevented a new employee from participating in the study, but non-English speaking persons were excluded from the study.

We distributed an implied consent form (Appendix C) and questionnaire (Appendix C) to each new employee during the orientation. The paper based form included a brief introduction, describing the purpose of the survey, and a message of appreciation from the UNC Health Care system, encouraging participation in the study. No other recruitment tactics were used. The participants were free to fill out the form at anytime during the day and in any location they choose. The forms were then self-submitted at the subjects' discretion, before the end of the orientation. No other follow-up was required from the subjects.

The questionnaire that followed the implied consent form included a series of closed-ended questions, multiple-choice questions and likert-scale type questions. The first two sections of the questionnaire asked for standard demographic information and assessed employee pertussis vaccination history. The following section asked questions about pertussis knowledge. In the last two sections, participants were asked to describe their attitudes and beliefs regarding immunization with vaccinations in general and immunization with the new Tdap vaccine in particular.

Data entry and analysis was performed by the author. All collected information was analyzed by statistical software (STATA 9). Data entry was checked for accuracy by double checking 5% of data entry. This survey assessed many standard variables (including age, sex, occupation, years of experience in the

health care field, and primary language spoken) to evaluate for social or demographic trends. In addition, we assessed the correlation between the outcome of the study and knowledge of pertussis and general perceptions of vaccination.

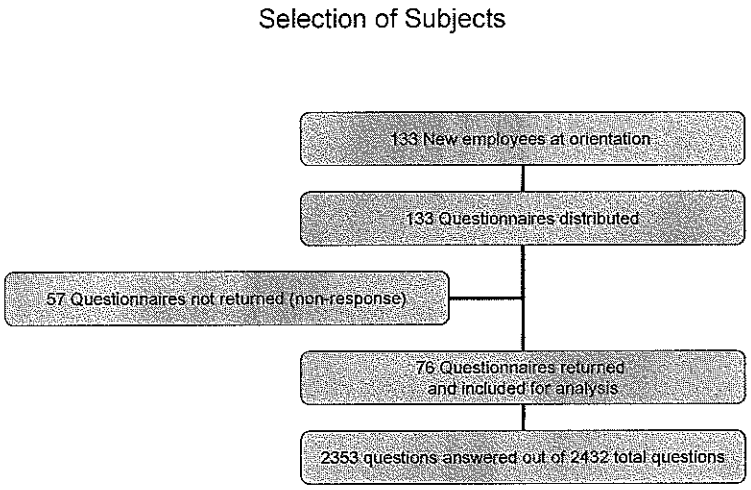
The survey was pre-approved by the UNC SPH IRB before administration to UNC employees (IRB #07-0417). This study involved no more than minimal risk to patients due to the nature of anonymous questionnaires. To ensure respondent confidentiality, the surveys did not request any identifiers, other than age and date of birth. A letter of implied consent, rather than formal consent, was used to further protect patient confidentiality from risk of harm by attaching identifying information to signed consent forms. All submitted forms will be kept confidential until the end of the study, when the questionnaires will be shredded. The data from the forms will be kept password protected at all times.

The survey was administered to a pilot group to evaluate the survey for clarity of questions, reproducibility, and neutrality of questions. To encourage adequate response rate, surveys were distributed and collected during orientation. To provide on-going evaluation of the survey performance and a tally of analysis, survey data were entered into the computer after each orientation session. In addition, we hoped to promote cooperation and honest responses, by asking for a minimal amount of potentially sensitive information.

Results of the Survey:

Study Size:

A majority of the subjects participated in the survey (see flow chart below). Of the 133 questionnaires that were distributed to all subjects at the new employee orientation, 76 surveys (57%) were returned. Most of the questions in the returned questionnaires were completed, with only a small fraction of questions (79/2432 = 3.2%) missing responses.



Demographics:

The subjects consisted of mostly English speaking females, under the age of 36 and with less than 16 years of experience in the health care field, although occupation was variable (see table below). 76% of respondents reported they were female. 88% of respondents reported that English was their primary language. Persons 25 years old or younger made up the largest subgroup of age

and consisted of 39% of the respondents. A majority of respondents (64%) had 5 or less years of experience in health care. Approximately one quarter of respondents listed their occupation as Nurse, although the largest subgroup (30%) consisted of persons who listed their occupation as "other".

Variable	Distribution of Responses (out of 76)	Percentage	Range, median, mean
Age	<26: 30 26-35: 25 36-45: 8 46-55: 9 >55: 4	<26: 39% 26-35: 33% 36-45: 11% 46-55: 12% >55: 5%	Range 18-73 Median 29 Mean 32.2 (SD 12.0)
Sex	Male: 18 Female: 57 *No response: 1	Male: 24% Female: 76%	
Primary Language	English: 67 Spanish: 3 Other: 6	English: 88% Spanish: 4% Other: 8%	
Years in health care	<6: 48 6-15: 17 16-25: 6 26-35: 3 >35: 1 *No response:1	<6: 64% 6-15: 23% 16-25: 8% 26-35: 4% >35: 1%	Range: 0-50 Median: 4 Mean: 6.8 (SD 9.4)
Occupation	Nurse: 19 Nurse Aid: 15 Technician: 7 Environmental Services: 4 Other: 30 Physician: 0 *No response: 1	Nurse: 25% Nurse Aid: 20% Technician: 10% Environmental Services: 5% Other: 30% Physician: 0%	

*Not included in the analysis of range, median, mean

Vaccine History:

Only four of the respondents indicated that they have an absolute contraindication for the Tdap vaccine, although some of the respondents were unsure of their vaccination contraindications (see table below). Three respondents (4%) indicated that they have already received the Tdap vaccine. One respondent (1%) indicated that they had a serious reaction to a tetanus vaccine in the past.

Pregnancy was not reported among respondents. 39% of the respondents were not sure if they had received the Tdap vaccine, 16% of the respondents were not sure if they have had a serious reaction to previous Td vaccine, and 4% of respondents were not sure if they were pregnant. Receiving the Tdap vaccine within 2 years of a previous Tetanus vaccine has not been recommended by the ACIP and 20% of respondents reported that they meet this description. 36% of respondents were not sure when their last tetanus was received.

Co-variate	Distribution of Responses (out of 76)	(%)
Already received the new Tdap vaccine	Yes: 3 No: 41 Not Sure: 28 *No Response: 4	Yes: 4% No: 57% Not Sure: 39%
Last tetanus vaccine was received	<2 years ago: 15 2-5 years ago:16 >5 years ago: 17 Not Sure: 27 *No Response: 1	<2 years ago: 20% 2-5 years ago: 21% >5 years ago: 23% Not Sure: 36%
Any serious reactions to the last tetanus vaccine	Yes: 1 No: 62 Not Sure: 12 *No Response: 1	Yes: 1% No: 83% Not Sure: 16%
Currently pregnant	Yes: o No: 73 Not Sure: 3	Yes: 0% No: 96% Not Sure: 4%

*Not included in analysis of percentage.

Pertussis Knowledge:

In general, the participants in the study were unable to correctly answer most of the knowledge questions (see table below). The average number correct on the knowledge section for all subjects was 1.6 (S.D. of 1.4) and the median number of correct answers was 1. 18 participants missed all of the questions. 54% of

participants (41 subjects) correctly answered one or two of the questions. Only 3 people (3%) answered more than 4 questions correctly.

Number correct out of 8 questions	Number of subjects (total: 76)	Percentage (total: 100%)
8/8 (100%)	0	0%
7/8 (88%)	1	1%
6/8 (75%)	1	1%
5/8 (63%)	1	1%
4/8 (50%)	2	3%
3/8 (38%)	12	16%
2/8 (25%)	17	22%
1/8 (13%)	24	32%
0/8 (0%)	18	24%

Perceptions of Vaccines in General:

In Section 4 of the survey, which asks participants to indicate whether they agree or disagree with several statements about vaccines in general, participants generally agreed strongly with the statement or felt that the statement was very important (see table below). Most of the statements had a median response of 9 and a mean response of 8 to 9, with the exception of the second statement "Vaccination will prevent me from getting a vaccine preventable disease?" and the third statement "Vaccination will prevent me from giving an infection to my patient?." These two statements had a median score of 8 and a mean score of 7 to 8.

Statement	Actual number of responses (Scale of 1 to 9, with 1 being "not important" and 9 being "very important")	Summary statistics

How important are vaccines in protecting the health of the public?	1:0, 2:0, 3:0, 4:1, 5:1, 6:0, 7:2, 8:13, 9:57 *No response: 2	Range: 4-9 Mean: 8.6 (SD: 0.9) Median: 9
Vaccination will prevent me from getting a vaccine preventable disease?	1:0, 2:1, 3:0, 4:3, 5:6, 6:3, 7:11, 8:18, 9:32 *No response: 2	Range: 2-9 Mean: 7.7 (SD: 1.6) Median: 8
Vaccination will prevent me from giving an infection to my patient?	1:1, 2:3, 3:1, 4:2, 5:4, 6:4, 7:10, 8:13, 9:36 *No response: 2	Range: 1-9 Mean: 7.6 (SD: 2.0) Median: 8
It is my responsibility to get vaccinated because I work at a hospital (if safe)?	1:1, 2:1, 3:1, 4:0, 5:2, 6:1, 7:5, 8:15, 9:46 *No response: 4	Range: 1-9 Mean: 8.2 (SD: 1.6) Median: 9
Persons who work in a hospital should be required to get vaccinated (if safe)?	1:1, 2:0, 3:0, 4:0, 5:2, 6:2, 7:5, 8:11, 9:53 *No response: 2	Range: 1-9 Mean: 8.4 (SD: 1.3) Median: 9
How important is it to you that UNC will pay for all vaccines given to health care workers?	1:0, 2:0, 3:0, 4:0, 5:1, 6:0, 7:2, 8:9, 9:62 *No response: 2	Range: 5-9 Mean: 8.7 (SD: 0.6) Median: 9
How important is it to you that UNC covers you with worker's compensation if you have any problems due to vaccines given by occupational health?	1:0, 2:0, 3:0, 4:0, 5:1, 6:1, 7:2, 8:11, 9:59 *No response: 2	Range: 5-9 Mean: 8.7 (SD: 0.7) Median: 9

*Not included in analysis of summary statistics.

Perceptions of Tdap Vaccine:

In Section 5 of the survey, which asks participants to indicate whether they agree or disagree with several statements about the Tdap vaccine, participants generally agreed strongly with the statement or felt that the statement was very important (see table below). Most of the statements had a median response of 9 and a mean response of 8 to 9, with the exception of the second statement "Vaccination will prevent me from getting a vaccine preventable disease?", the third statement "Vaccination will prevent me from giving an infection to my patient?" and the fourth statement "It is my responsibility to get vaccinated because I work at a

hospital (if safe)?" These three statements had a mean score of 7 to 8 with a median score of 8 for the second and third statement and a median score of 9 for the fourth statement.

Statement	Actual number of responses (Scale of 1 to 9, with 1 being "not important" and 9 being "very important")	Summary statistics
How important are vaccines in protecting the health of the public?	1:0, 2:0, 3:0, 4:0, 5:5, 6:4, 7:8, 8:14, 9:39 *No response: 6	Range: 5-9 Mean: 8.1 (SD: 1.4) Median: 9
Vaccination will prevent me from getting a vaccine preventable disease?	1:0, 2:0, 3:0, 4:4, 5:10, 6:4, 7:10, 8:12, 9:29 *No response: 7	Range: 4-9 Mean: 7.5 (SD: 1.7) Median: 8
Vaccination will prevent me from giving an infection to my patient?	1:0, 2:1, 3:2, 4:3, 5:6, 6:4, 7:9, 8:16, 9:29 *No response: 6	Range: 2-9 Mean: 7.5 (SD: 1.8) Median: 8
It is my responsibility to get vaccinated because I work at a hospital (if safe)?	1:1, 2:0, 3:1, 4:0, 5:7, 6:2, 7:10, 8:12, 9:38 *No response: 5	Range: 1-9 Mean: 7.9 (SD: 1.7) Median: 9
Persons who work in a hospital should be required to get vaccinated (if safe)?	1:0, 2:0, 3:1, 4:0, 5:9, 6:1, 7:6, 8:16, 9:38 *No response: 5	Range: 3-9 Mean: 8.0 (SD: 1.5) Median: 9
How important is it to you that UNC will pay for all vaccines given to health care workers?	1:1, 2:0, 3:0, 4:1, 5:3, 6:0, 7:3, 8:12, 9:51 *No response: 5	Range: 1-9 Mean: 8.4 (SD: 1.4) Median: 9
How important is it to you that UNC covers you with worker's compensation if you have any problems due to vaccines given by occupational health?	1:1, 2:0, 3:0, 4:1, 5:3, 6:0, 7:1, 8:13, 9:52 *No response: 5	Range: 1-9 Mean: 8.4 (SD: 1.4) Median: 9

*Not included in analysis of summary statistics.

Correlation:

The correlation between the perceptions of the Tdap vaccine and the general perceptions of vaccines (baseline) can be found by using the Spearman's Test of correlation used for data with a non-normal distribution (see table below). We find that the respondents perceptions of the Tdap vaccine were very highly

correlated with their general perceptions of vaccines among all 7 statements. Further analysis reveals that the median difference is zero and the average difference is a fraction negative for all 7 questions.

Statement	Analysis	Summary statistics	Difference from baseline*
How important are vaccines in protecting the health of the public?	Spearman's correlation: 0.59 **(significant p<0.001)**	Range: -4 to 1 Mean: -0.5 (SD: 1.0) Median: 0	-9: 0, -8:0, -7:0, -6:0, -5:0, -4:1, -3:4, -2:6, -1:13, 0:43, 1:1, 2:0, 3:0, 4:0, 5:0, 6:0, 7:0, 8:0, 9:0 ~No response: 6
Vaccination will prevent me from getting a vaccine preventable disease?	Spearman's correlation: 0.77 **(significant p<0.001)**	Range: -4 to 3 Mean: -0.3 (SD: 1.1) Median: 0	-9: 0, -8:0, -7:0, -6:0, -5:0, -4:1, -3:1, -2:6, -1:10, 0:44, 1:4, 2:2, 3:1, 4:0, 5:0, 6:0, 7:0, 8:0, 9:0 ~No response: 7
Vaccination will prevent me from giving an infection to my patient?	Spearman's correlation: 0.84 **(significant p<0.001)**	Range: -4 to 6 Mean: -0.0 (SD: 1.2) Median: 0	-9: 0, -8:0, -7:0, -6:0, -5:0, -4:2, -3:0, -2:2, -1:8, 0:49, 1:5, 2:2, 3:1, 4:0, 5:0, 6:1, 7:0, 8:0, 9:0 ~No response: 6
It is my responsibility to get vaccinated because I work at a hospital (if safe)?	Spearman's correlation: 0.78 **(significant p<0.001)**	Range: -4 to 7 Mean: -0.3 (SD: 1.3) Median: 0	-9: 0, -8:0, -7:0, -6:0, -5:0, -4:1, -3:4, -2:2, -1:11, 0:49, 1:1, 2:0, 3:0, 4:0, 5:0, 6:0, 7:1, 8:0, 9:0 ~No response: 7
Persons who work in a hospital should be required to get vaccinated (if safe)?	Spearman's correlation: 0.61 **(significant p<0.001)**	Range: -4 to 7 Mean: -0.4 (SD: 1.4) Median: 0	-9: 0, -8:0, -7:0, -6:0, -5:0, -4:4, -3:2, -2:4, -1:10, 0:48, 1:2, 2:0, 3:0, 4:0, 5:0, 6:, 7:1, 8:0, 9:0 ~No response: 5
How important is it to you that UNC will pay for all vaccines given to health care workers?	Spearman's correlation: 0.56 **(significant p<0.001)**	Range: -8 to 2 Mean: -0.4 (SD: 1.3) Median: 0	-9: 0, -8:1, -7:0, -6:0, -5:0, -4:2, -3:1, -2:1, -1:8, 0:56, 1:1, 2:1, 3:0, 4:0, 5:0, 6:, 7:0, 8:0, 9:0 ~No response: 5
How important is it to you that UNC covers you with worker's compensation if you have any problems due to vaccines given by occupational health?	Spearman's correlation: 0.63 **(significant p<0.001)**	Range: -8 to 1 Mean: -0.3 (SD: 1.2) Median: 0	-9: 0, -8:1, -7:0, -6:0, -5:0, -4:2, -3:0, -2:0, -1:7, 0:56, 1:5, 2:0, 3:0, 4:0, 5:0, 6:0, 7:0, 8:0, 9:0 ~No response: 5

*Difference = tdap value – general value. Scale of -9 to 9, with negative numbers indicating that the Tdap vaccine is less important or less agreement, zero being no change in perception, and positive numbers indicating that the Tdap vaccine is more important.
~Not included in analysis of summary statistics.

Other co-variates were also checked for possible correlations (see table below).

No significant correlation was found for any of the co-variates including: age, sex, primary language, years in health care and occupation.

Statement	Age	Sex	Primary Language	Years in health care	occupation	Number correct
How important are vaccines in protecting the health of the public?	Spearman's correlation: p=0.17 **(not significant)**	Wilcoxon Rank-sum: p=0.94 **(not significant)**	Kruskal-Wallis Test: p=0.39 **(not significant)**	Spearman's correlation: p=0.33 **(not significant)**	Kruskal-Wallis Test: p=0.24 **(not significant)**	Spearman's correlation: p=0.83 **(not significant)**
Vaccination will prevent me from getting a vaccine preventable disease?	Spearman's correlation: p=0.20 **(not significant)**	Wilcoxon Rank-sum: p=0.98 **(not significant)**	Kruskal-Wallis Test: p=0.14 **(not significant)**	Spearman's correlation: p=0.19 **(not significant)**	Kruskal-Wallis Test: p=0.32 **(not significant)**	Spearman's correlation: p=0.49 **(not significant)**
Vaccination will prevent me from giving an infection to my patient?	Spearman's correlation: p=0.09 **(not significant)**	Wilcoxon Rank-sum: p=0.79 **(not significant)**	Kruskal-Wallis Test: p=0.10 **(not significant)**	Spearman's correlation: p=0.25 **(not significant)**	Kruskal-Wallis Test: p=0.17 **(not significant)**	Spearman's correlation: p=0.51 **(not significant)**
It is my responsibility to get vaccinated because I work at a hospital (if safe)?	Spearman's correlation: p=0.06 **(not significant)**	Wilcoxon Rank-sum: p=0.87 **(not significant)**	Kruskal-Wallis Test: p=0.37 **(not significant)**	Spearman's correlation: p=0.23 **(not significant)**	Kruskal-Wallis Test: p=0.44 **(not significant)**	Spearman's correlation: p=0.64 **(not significant)**
Persons who work in a hospital should be required to get vaccinated (if safe)?	Spearman's correlation: p=0.07 **(not significant)**	Wilcoxon Rank-sum: p=0.70 **(not significant)**	Kruskal-Wallis Test: p=0.21 **(not significant)**	Spearman's correlation: p=0.17 **(not significant)**	Kruskal-Wallis Test: p=0.23 **(not significant)**	Spearman's correlation: p=0.42 **(not significant)**
How important is it to you that UNC will pay for all vaccines given to health care workers?	Spearman's correlation: p=0.66 **(not significant)**	Wilcoxon Rank-sum: p=0.21 **(not significant)**	Kruskal-Wallis Test: p=0.51 (not significant)	Spearman's correlation: p=0.98 (not significant)	Kruskal-Wallis Test: p=0.92 (not significant)	Spearman's correlation: p=0.86 (not significant)
How important is it to you that UNC covers you with worker's compensation if you have any problems due to vaccines given by occupational health?	Spearman's correlation: p=0.45 **(not significant)**	Wilcoxon Rank-sum: p=0.90 **(not significant)**	Kruskal-Wallis Test: p=0.50 **(not significant)**	Spearman's correlation: p=0.52 **(not significant)**	Kruskal-Wallis Test: p=0.73 **(not significant)**	Spearman's correlation: p=0.51 **(not significant)**

Limitations

I have assessed the internal and external validity of this study in a similar manor as the rest of the systematic review articles (See critical appraisal of Jordan et al). Minor limitations of this study include small study group size (76), a non-response rate of 43% and the nature of self-reported data. Additionally, one major demographic of health care workers that was missing in this study is the physician representation. Physicians were not intentionally excluded, but were not at the orientation because the new resident physician employees under go orientation in the summer time, at the start of their residency, and new attending physicians undergo orientation through the university system, as faculty members.

For external generalizability, this questionnaire has poor generalizability because it is a single non-randomized trial, with a small sample size, drawn from a convenience sample. Other populations may feel very differently about the new Tdap vaccine, especially given different circumstances such as if the Tdap vaccine was not a requirement for employment or if the hospital did not pay for the vaccine. Furthermore, we currently do not have any data from physicians. It would be difficult to make broad conclusions about the perceptions of health care workers in general without surveying physicians.

Discussion of the survey:

Most of the data from the questionnaire produced a non-normal distribution, which required special tests of correlation to properly analyze the data. Spearman's correlation was used for the comparison of perceptions of the Tdap

vaccine and vaccines in general because the X and Y variable were both continuous variables. The spearman's correlation is analogous to the pearson's correlation, but uses ranked data (rather than the actual value) to control for skewed data. The spearman's correlation was also used to analyze perception of Tdap vaccine by age, years in health care and number of questions correct. Wilcox ranksum was used for the comparison of the perceptions of Tdap vaccine and sex because perceptions of the Tdap vaccine are continuous variables and sex is a two category variable. The Wilcox ranksum is analogous to the 2-sample t-test, but uses ranked data (rather than the actual value) to control for skewed data. Kruskal-wallis test was used for the comparison of the perceptions of the Tdap vaccine by primary language and occupation because the perceptions of the Tdap vaccine are continuous variables and language and occupation have more than 2 categories. The Kruskal-wallis test is analogous to the one-way ANOVA, but uses ranked data (rather than the actual value) to control for skewed data.

The subjects of this study indicated that the Tdap vaccine is very important to protect the public health, as well as agree that the Tdap vaccine will prevent them and their patients from getting sick. Even though they agree that vaccination is a personal responsibility, they also feel that society should require persons who work at a hospital to get vaccinated. Both the fact that UNC pays for vaccines and that problems caused by required vaccine are covered by workman's comp are very important to test subjects. However, the perceptions expressed about the Tdap vaccine are very highly correlated with the general perceptions of vaccines

and may be difficult to distinguish any differences between the two sets of perceptions.

We can speculate as to why health care workers might not object to the new pertussis booster recommendation. It could be that health care workers are not inconvenienced by the new vaccine since it is replacing the previously recommended Td booster and not adding an additional injection to the immunization schedule. Health care workers could be comfortable with the vaccine because fears about pertussis vaccination side-effects or infection with pertussis due to vaccination are not common among health care workers or the general media. Since the Tdap vaccine in this study was administered free of charge through the occupational health department to new employees, the surveyed health care workers may not have to overcome the financial barriers associated with other immunization requirements. Health care workers may be comfortable with the new vaccine because most of the U.S. population has received multiple doses of the Tdap vaccine through the recommended immunization schedule of children. Finally, health care workers may simply not realize that the combined Tdap vaccine booster is a significant change from the previous recommendation.

The majority of the respondents were unable to correctly answer most of the knowledge questions about pertussis. This lack of knowledge about pertussis is surprising given that the participants of the study are health care workers,

acellular pertussis is part of the routine DTap vaccine for children and that many of them have numerous year of experience in the health care field. It suggests that pertussis may be an under-recognized cause of upper respiratory illness. This supports cherry's claim that pertussis may be more prevalent than we realize[5].

Other co-variates were not found to be significant enough for further investigation of correlation to perception of Tdap vaccine. This suggests that beliefs and attitudes about the Tdap vaccine may be consistent across subgroups.

IV. Combined Master's Paper Discussion:

This master's paper consists of a complete systematic review of the barriers to immunization among health care workers and performs a research study of health care workers perceptions of the new Tdap vaccine recommendation, complete to data collection and analysis. Several comparisons between the results of the systematic review and the research study can be made.

In this survey of HCW perceptions of the Tdap vaccine, we evaluated HCWs' perception of Tdap vaccine's effectiveness, as a public health measure, personal preventive measure and nosocomial infection control measure. Most people felt the Tdap was a very important public health measure and strongly agreed that the Tdap was a good personal preventive measure and nosocomial infection control measure. This is response is very different from the results of the influenza vaccines performed by Goldstein et al, Toy et al and Weingarten et al. The studies of influenza suggests that between 11% and 53% of people feel that the influenza vaccine is not effective.

In this survey of HCW perceptions of the Tdap vaccine, we evaluated HCWs' willingness to have a mandatory Tdap requirement. Most people strongly agreed that they are willing to have required Tdap vaccinations. This is response is very different from the results reported by Goldstein et al about the influenza vaccine. Goldstein et al found that only 40% of the respondents would support a statewide law mandating influenza vaccinations for all HCWs with direct patient contact

and only 49% of the respondents would support a facility-wide regulation mandating influenza vaccinations for all HCWs with direct patient contact.

Two other barriers to immunization that this survey evaluated were HCWs' perception of the risk of side-effects and the cost of the Tdap vaccine as barriers to immunization. Most people felt that free vaccines and having workman's compensation to cover any problems due to the Tdap vaccine were very important. This is response is very similar to the articles in the systematic review which reported that side-effects were a reported barrier to immunization in five studies and cost was reported a reported barrier to immunization in four studies. The systematic review suggests that between 0.7% and 68% of participants may report cost or side-effects are a barrier to immunization.

Unlike some of the other studies found in the systematic review, this study does not have any correlation to participant characterisitics such as age, sex, occupation, primary language, years in health care or knowledge about pertussis.

The willingness of the HCWs surveyed to accept the new Tdap vaccine requirement suggest that, within our study population, either the barriers seen with other common vaccines have been overcome with the new Tdap vaccine requirement at UNC or the barriers seen with other common vaccines do not apply to the new Tdap vaccine requirement at UNC.

The Tdap survey is the only survey discussed in this master's paper to attempt to record a baseline of health care worker perceptions of vaccines. This is particularly useful for two reasons. First, the questions about vaccines in general allow us to generate a reference frame for those participants taking the survey before they consider their perceptions of the Tdap vaccine. Second, if there were any strongly positive or strongly negative perceptions of Tdap vaccine, the reference to perceptions of vaccines in general would allow us to better understand what a strong response to the Tdap vaccine would mean.

The results of this survey suggest that the Tdap vaccine recommendation for health care workers has the potential to be a good public health intervention. Estimated rates of pertussis infections are very high, so the benefit to society of reducing pertussis may be substantial. Perhaps equally important, for public health interventions, is that the Tdap vaccine has minimal risks associated with its use. If the Tdap vaccine proves to be effective in reducing pertussis infections among health care workers or nosocomial pertussis infections, the large benefit to risk ratio and the ease of implementation will likely make the Tdap vaccine a good public health intervention.

V. Conclusion:

Numerous examples from the literature suggest that achieving a high immunization rate of a recommended vaccine is difficult to achieve and often met with resistance from health care workers. A systematic review of the literature finds that individual barriers and systematic barriers contribute to low rates of immunizations. However, the results of this study indicate that health care workers support the new requirement of Tdap vaccination and that barriers to Tdap immunization may be overcome with relatively little effort. Furthermore, UNC Health Care System's Tdap vaccination requirement is an appropriate health care policy and other health care facilities should strongly consider similar Tdap vaccination mandates.

REFERENCES

1. CDC. Preventing tetanus, diptheria, and pertussis among adolescents: Use of tetanus toxoid, reduced diptheria toxoid, and acellular pertussis vaccines. recommendations of the advisory committee on immunization practices (ACIP). *MMWR*. 2006;55:RR-3.

2. CDC. Preventing tetanus, diptheria, and pertussis among adults: Use of tetanus toxoid, reduced diptheria toxoid and acellular pertussis vaccine. recommendations of the advisory committee on immunization practices. *MMWR*. 2006;55.

3. Guris D, Strebel PM, Bardenheier B, et al. Changing epidemiology of pertussis in the united states: Increasing reported incidence among.. *Clinical Infectious Diseases*. 1999;28:1230.

4. CDC. Final 2005 reports of notifiable diseases. *MMWR*. 2006;55:880--1.

5. Cherry JD. The epidemiology of pertussis: A comparison of the epidemiology of the disease pertussis with the epidemiology of bordetella pertussis infection. *Pediatrics*. 2005;115:1422-1427.

6. McQuillan GM, Kruszon-Moran D, Deforest A, Chu SY, Wharton M. Serologic immunity to diphtheria and tetanus in the united states. *Ann Intern Med*. 2002;136:660-666.

7. CDC.
Percentage of persons aged >18 years who reported receiving influenza or pneumococcal vaccine or tetanus toxoid, by age and selected characteristics—National health interview survey, united states, 1999. Available at: http://www.cdc.gov/nip/coverage/NHIS/tables/general-99.pd. Accessed 3/27, 2007.

8. Jenkinson D. Duration of effectiveness of pertussis vaccine: Evidence from a 10 year community study. *Br Med J (Clin Res Ed)*. 1988;296:612-614.

9. He Q, Viljanen MK, Nikkari S, Lyytikainen R, Mertsola J. Outcomes of bordetella pertussis infection in different age groups of an immunized population. *J Infect Dis*. 1994;170:873-877.

10. Heininger U. An internet-based survey on parental attitudes towards immunization. *Vaccine*. 2006/9/11;24:6351-6355.

11. Szucs TD, Muller D. Influenza vaccination coverage rates in five european countries-a population-based cross-sectional analysis of two consecutive influenza seasons. *Vaccine*. 2005;23:5055-5063.

12. Hofmann F, Ferracin C, Marsh G, Dumas R. Influenza vaccination of healthcare workers: A literature review of attitudes and beliefs. *Infection.* 2006;34:142-147.

13. Jones TF, Ingram LA, Craig AS, Schaffner W. Determinants of influenza vaccination, 2003-2004: Shortages, fallacies and disparities. *Clin Infect Dis.* 2004;39:1824-1828.

14. Irigoyen MM, Findley S, Wang D, et al. Challenges and successes of immunization registry reminders at inner-city practices. *Ambul Pediatr.* 2006;6:100-104.

15. Wirsing von Konig CH, Campins-Marti M, Finn A, Guiso N, Mertsola J, Liese J. Pertussis immunization in the global pertussis initiative european region: Recommended strategies and implementation considerations. *Pediatr Infect Dis J.* 2005;24:S87-92.

16. ACIP Staff. NIP: ACIP/Main page. Available at: http://www.cdc.gov/nip/acip/. Accessed Feb 9, 2007.

17. Goldstein AO, Kincade JE, Gamble G, Bearman RS. Policies and practices for improving influenza immunization rates among healthcare workers. *Infect Control Hosp Epidemiol.* 2004;25:908-911.

18. Nichol KL, Hauge M. Influenza vaccination of healthcare workers. *Infect Control Hosp Epidemiol.* 1997;18:189-194.

19. Statistical survey. Available at: http://en.wikipedia.org/wiki/Statistical_survey. Accessed April 13, 2007.

20. Newcomer K, Triplett T. Using surveys. In: Wholey J, Hatry H, Newcomer K, ed. *Handbook of Practical Program Evaluation.* 2nd ed. San Francisco, CA: Jossey-Bass; 2004:257--91.

21. Weingarten S, Riedinger M, Bolton LB, Miles P, Ault M. Barriers to influenza vaccine acceptance A survey of physicians and nurses. *American Journal of Infection Control.* 1989/8;17:202-207.

22. Toy WC, Janosky JE, Laird SB. Influenza immunization of medical residents: Knowledge, attitudes, and behaviors. *Am J Infect Control.* 2005;33:473-475.

23. Martinello RA, Jones L, Topal JE. Correlation between healthcare workers' knowledge of influenza vaccine and vaccine receipt. *Infect Control Hosp Epidemiol.* 2003;24:845-847.

24. Lee DJ, Carrillo L, Fleming L. Epidemiology of hepatitis B vaccine acceptance among urban paramedics and emergency medical technicians. *American Journal of Infection Control.* 1997/10;25:421-423.

25. Jacobson JJ, Lang WP, Ybanez MS, Shipman C,Jr, Johnston FK, LaTurno DE. Acceptance of hepatitis B vaccine among dental health care workers. *J Public Health Dent.* 1989;49:67-72.

26. Qureshi M, Gordon SM, Yen-Lieberman B, Litaker DG. Controlling varicella in the healthcare setting: Barriers to varicella vaccination among healthcare workers. *Infect Control Hosp Epidemiol.* 1999;20:516-518.

27. Weber DJ, Rutala WA. Vaccines for health care workers. In: Plotkin SA, Orenstein WA, ed. *Vaccines.* Philadelphiad: Saunders; In Press.

Appendix A: Critical Appraisal Summary

Title	Overall assessment**	Methodological problems
Goldstein et al. Increasing Influenza Immunizations Among HCWs. 2004	Good quality	Major: None Minor: - 13% non-response rate (44/312) - medium size survey: 268 responses - Self-reported survey data
Nichol et al. Influenza vaccination of health care workers. 1997	Good quality	Major: None Minor: - 62% non-response rate (639/1031) - medium size survey: 392 - self-reported survey data
Weingarten et al. Barriers to influenza vaccine acceptance: a survey of physicians and nurses. 1989	Good quality	Major: None Minor: - 58% non-response rate (270/463) - medium size survey: 193 - self-reported survey data
Toy et al. Influenza immunization of medical residents: knowledge, attitudes and behaviors.2005	Fair quality	Major: - very small subgroups (25 subjects vaccinated and 18 subjects not vaccinated) Minor: - 0% non-response rate (0/43) - small size survey: 43 - self-reported survey data
Martinello et al. Correlation between health care workers'	Fair quality	Major: - Most statistical analysis performed on aggregate data of "nurses" vs "physicians" Minor:

knowledge of influenza vaccine and vaccine receipt. 2003		- 1% non-response rate (3/215) - Medium size survey: 212 - self-reported survey data
Lee et al. epidemiology of hepatitis b vaccine acceptance among urban paramedics and emergency medical technicians.1997	Fair quality	Major: - considered those who have had hepatitis B in with those who reported not to have vaccine. - the backward logistic regression did not evaluate history of blood exposures as a predictor for hepatitis vaccination. Minor - 76% non-response rate (954/1250) - an additional 5% were excluded after drop-outs (total 81%) - medium size survey: 255 - self-reported survey data
Jacobson et al. Acceptance of Hepatitis B vaccine among dental health care workers. 1989	Poor quality	Major: - poor analysis and conclusions: ▪ Analyzed data with exposure (dependent variable or X) was acceptance/nonacceptance of Hepatitis B (see results on pg 70). Yet, the analysis routinely refers to various factors (dependent variable) which are determinants of Hepatitis acceptance/nonaccpetance (outcome, independent variable or Y). ▪ Incorrectly calculated data: vaccine acceptance rate of students is listed in the table as 495 out of 555 = 89.2%. yet is quoted in the results as 93% acceptance. Also, the table lists 664 subjects out of 976 total accepted the vaccination (vaccination rate = 68.0%). Yet, the text under methods states that 667 persons out of 979 total accepted the vaccination (vaccination rate = 68.1%). Both of these numbers are than the difference of 68.5% stated in the results section on page 68. If these simple calculations cannot be performed correctly, I am suspicious that none of the calculations are performed correctly. ▪ Retrospectively adjusted data for analysis: "when expected chi-square frequencies were found to be less than five, categories were collapsed appropriately to increase the number of respondents in a particular group" (methods pg 68). ▪ Considered those who may have had previous vaccination or whose vaccination status is unknown as nonacceptance for purposes of analysis. This would mean there is the potential for vaccinated individuals to be in the "nonaccpetance" grouping. ▪ "at risk" was analyzed as a dichotomous variable, with >2% means yes and <2% means no, even though the table clears shows that there is more than 2 categories. - Faculty and staff paid $105 for vaccine, students paid $25

		- arbitrary definition of "at risk" set at >2% of time in patient contact. - would probably be more appropriate to evaluate patient contact time as a continuous variable, or at least have categories with equal distribution of time in patient contact (eg <25%, 25-50%, 51-75%, >75%). Minor: - 40% non-response rate (390/976) - medium size survey: 586 responses - self-reported survey data
Queresh et al. Controlling varicella in health care setting: barriers to varicella vaccination among health care workers.1999	Fair quality	Major: - Retrospective exclusion of 24% of participants from the study because they did not recall receiving notice of their immunization status and offer for free vaccination in the mail - numbers of people who expressed opinions about receiving the vaccine (38) or did not receive the vaccine (15) are very small subgroups. Minor: - 22% non-response rate (20/90) - small size survey: 70/90 - self-reported survey data

**Overall Assessment categories: Good (well designed study with conclusions that can be applied to intended population), Fair (study does not have many major flaws with conclusions that should be interpreted with caution); Poor (study has several major flaws with conclusions that should be considered invalid).

Appendix B: Summary of Findings

Title	Findings
Goldstein et al. Increasing Influenza Immunizations Among HCWs. 2004	- Overall, 38% of institutions have formal written polities regarding employee influenza vaccination - institutions with formal written policy: 70% hospitals, 49% home health, 44% nursing homes, 26% dialysis centers, 14% assisted living - the rest either no written policy or unsure if a policy existed. - Hospitals were significantly more likely to have written employee influenza policies than other institutions - assisted living centers were significantly less likely to have written polities than other institutions. - Of those that had written policies, 2% have mandatory annual influenza vaccinations - Of those that had written policies, institutions with mandatory annual influenza vaccination: 4% hospitals, 4% home health. - the rest no mandatory requirement - Of those that had written policies, 88% of the institutions reported relying on voluntary measures such as annual reminders to implement their policies - Of those that had written policies, 88% of institutions had annual reminders - Of those that had written policies, 69% reported having free vaccinations as a mechanism to encourage employee vaccination - Of those that had written policies, 52% reported having educational efforts as a mechanism to encourage empoloyee vaccination - Of those that had written policies, 32% reported having low-cost vaccines as a mechanism to encourage empoloyee vaccination - Of those that had written policies, 13% reported having vaccination drives as a mechanism to encourage empoloyee vaccination - Of those that had written policies, voluntary measures: hospitals: 83% annual reminder, 13% other; home health agencies: 93% annual reminder, 4% other; nursing homes: 88% annual reminder, 12% other; dialysis centers: 80% annual reminder, 20% other; assisted living facilities: 86% annual reminder, 13% other - assisted living centers were 3 times less likely to offer free influenza vaccinations compared with other institutions. ($p<0.001$) - Hospitals and nursing homes reported using educational efforts significantly more often than home health agencies, dialysis centers, or assisted living facilities. ($p<0.001$) - Overall, reported barriers to receiving vaccination: "fear of side effects" (68%), "perceived ineffectivenss of vaccine"(53%), "fear of needles" (26%), "enforcing the policy" (11%), "money issues" (7%) and other (36%). - barriers to receiving vaccination by institution: Hospital - "fear of side effects" (77%), "perceived ineffectivenss of vaccine"(67%), "enforcing the policy" (21%), "money issues" (3%) and other (43%). Home Health - "fear of side effects" (65%), "perceived ineffectivenss of vaccine"(43%), "enforcing the policy" (2%), "money issues" (2%) and other (13%). Nursing Home - "fear of side effects" (74%), "perceived ineffectivenss of vaccine"(48%), "enforcing the policy" (21%), "money issues" (3%) and other (52%).

	Dialysis center - "fear of side effects" (79%), "perceived ineffectivenss of vaccine"(42%), "enforcing the policy" (0%), "money issues" (0%) and other (26%). Assisted living- "fear of side effects" (57%), "perceived ineffectivenss of vaccine"(66%), "enforcing the policy" (4%), "money issues" (19%) and other (31%). - Overall, 40% of the respondents indicated support for statewide laws mandating influenza vaccinations for all HCWs with direct patient contact - Overall, 49% of the respondents indicated support for facility-wide regulations mandating influenza vaccinations for all HCWs with direct patient contact - Of those not supporting a state law, 61% felt that the decision should be a personal one - Of those not supporting a state law, 48% felt that that such immunizations should not be mandated - Of those not supporting a state law, 24% felt that the law would not work - Of those not supporting a state law, 5% felt that the law would be too difficult to administer.
Nichol et al. Influenza vaccination of health care workers. 1997	- Overall, the response rate was 38.0% (392/1031) - overall, mean age of respondents was 43.6 years - overall, 71.5% were female - overall, 26.2% were physicians." Overall - 67.1% were vaccinated > or = 1 time in the preceding 5 years - 67.4% intended to be vaccinated next year - 95.5% recommend vaccination to high-risk patients Vaccine recipients - 86.4% were vaccinated > or = 1 time in the preceding 5 years - 96.2% intended to be vaccinated next year - 97.4% recommend vaccination to high-risk patients Non-recipients - 39.5% were vaccinated > or = 1 time in the preceding 5 years - 21.5% intended to be vaccinated next year - 92.3% recommend vaccination to high-risk patients - Vaccine recipients were found to be significantly older than non-recipients (45.4 v. 40.3), more likely to be a physician (33.6% v. v 14.6%), more likely to have been vaccinated in the preceding 5 years (86.4% v 39.5%) and more likely to intend to be vaccinated next year (96.2% v 21.5%).

	- among vaccine recipients persons who ranked each variable as very high were "not wanting to get sick" (82.5%), "protecting patients" (61.7%), "convenience" (68.3%), "free vaccine" (58.3%), "national recommendations" (25%), and "physicians recommendation" (7.9%). - among non-recipients persons who ranked each variable as very high were "concern about side effects" (36.2%), "not in target group" (14.5%), "inconvenience" (9.9%), "disagree with recommendations" (9.9%), "do not have contact with high-risk patients" (5.9%), "don't like needles" (5.3%), "forgot" (4.6%), and "cost"(0.7%). - Vaccine recipients were significantly more likely than were vaccine nonrecepients to indicate that influenza and its complications are very serious for high-risk patients, that the vaccine is very effective, that influenza vaccination is uncommonly associated with side effects, that healthcare workers' risk for contracting influenza is higher than the general public's risk, and that it is very important for healthcare workers to receive the vaccine to decrease risk for transmission to high-risk patients. - stepwise regression reveals "previous receipt of influenza vaccine" (5.4 OR), "annual influenza vaccinations for health care workers considered very important for the protections of patients" (4.9 OR), "physician (versus RN or LPN)" (2.2 OR), "Influenza vaccine considered to be very effective" (2.2 OR), " influenza vaccination considered to be associated with systemic side effects in <1% of recipeients" (2.0 OR), and age (1.04 OR for each increasing year).
Weingarten et al. Barriers to influenza vaccine acceptance: a survey of physicians and nurses. 1989	- 41.1% (193/463) response rate. - 5% of subjects reported using either a monovalent or trivalent influenza vaccine - 4.2% of subjects reported using amantadine chemoprophylaxis - 35% reported having an influenza like illness during the period of documented influenza activity in the hospital - 77% reported that they took care of patients while having an illness. - reasons to decline immunization "avoid medications whenever possible" (59%), "vaccine administration inconvenient" (31%), "concerned about a severe reaction" (29%), "concern about getting influenza from the vaccine" (25%), "vaccine ineffective" (24%), "concern about the pain" (12%), "prior adverse reaction to the vaccine" (5%), "vaccine too expensive" (5%), and "allergic to vaccine" (1%). - Nurses were more likely to report "avoid medications whenever possible" (71% vs 42%), "concerned about a severe reaction" (42% vs 12%), "concern about getting influenza from the vaccine" (40% vs 7%), "vaccine ineffective" (38% vs 8%) and "concern about the pain" (17% vs 5%) than physicians as a reason to decline immunization. ($p < 0.05$) - ways to make vaccination more acceptable the following year "if it were a national health care policy" (73%), "if the vaccine had little risk" (55%), "if immunization were more convenient" (53%), and "if the vaccine were free" (47%). - Nurses were more likely to report "if the vaccine had little risk" (66% vs 41%) than physicians as a way to make vaccination more acceptable the following year. ($p < 0.05$) - reasons why they worked while sick "did not want others to perform the work" (78%), "not sick enough to stay home"(65%), "had important

	work to be done that day" (60%), "did not want to use sick time" (24%), and "no sick time left" (9%). - Nurses were more likely to report "no sick time left" (19% vs 0%) than physicians as a reason to work while sick. ($p < 0.05$) - Physicians were more likely to report "did not want others to perform the work" (90% vs 65%) and "had important work to be done that day (90% vs 29%) than nurses as a reason to work while sick. ($p < 0.05$)
Toy et al. Influenza immunization of medical residents: knowledge, attitudes and behaviors. 2005	- Overall, influenza vaccination was 58.1% (67% of family medicine, 60% of internal medicine, and 45.5% of surgery, not significant difference). - Resident influenza immunization rate in this sample was higher than the national average for healthcare workers. - Most of the residents fell between 2 age groups: 18 to 29 (55.8%) years of age and 30 to 39 (39.5%) years of age. - First year residents composed 45.2% of the respondents, second year 28.6%, third year 21.4%, and fifth year 4.8%. -- 97.6% of the residents reported excellent to good health - 25.6% (11/43) residents reported having kids ,<16 years of age - 91% of the residents knew that the vaccine was being offered for free - 92% of the residents believed that receiving the vaccine was convenient. - 95.3% of residents would recommend the vaccine to others. - Immunization rates were significantly associated with postgraduate level, prior vaccination, media influence, whether they knew co-residents who were vaccinated, medical knowledge scores, and plan to be vaccinated next year. - A significant difference in immunization rates by postgraduate year was found, with PGY-1 at 47.4%, PGY-2 at 50%, and PGY-3 at 100%. - 86% of the residents knew co-residents who were vaccinated, which was found to be a significant predictor of immunization rates. - 61% of respondents reported prior influenza vaccination. - 81% of residents reported that they plan to get the influenza vaccine next season, which was significantly higher among the respondents who received the vaccine this year. - "The media were determined to be a significant factor positively influencing a resident's decision to be vaccinated (P # .001)." - "All of the 5 residents who reported being influenced in their decision to be vaccinated by the media received the vaccine." - "Immunization rates by age, sex, type of medical school (international/United States), whether or not they had children under age of 16 years, whether or not they would recommend the vaccine to patients, and the respondents' health status were not significant." - Numerous reasons for getting vaccinated were cited by those who received the vaccine including: "at risk because of their work" (80%), "risking transmission to patients" (68%), "influenza vaccine generally safe" (56%), "influenza vaccine is effective" (36%), "flu is a serious

	disease" (28%), "encouraged by other employees" (24%), "chronic illness" (4%). - 18 residents (41.9%) did not receive the influenza vaccine and their reasons are as follows: "procrastinated/forgot" (44%), "not interested" (16.7%), "not in high-risk group" (16.7%), "not likely to get flu" (16.7%), "vaccine is not effective" (11.1%), "do not like needles"(11.1%), "concern about adverse effects" (11.1%), "concern about pain/discomfort" (11.1%), "flu is not a serious disease" (11.1%), "did not know it was available" (5.6%), "allergic to the vaccine" (5.6%). - "In terms of recommending the influenza vaccine to resistant patients, most of the residents would either ''most likely'' (54.8%) or ''very strongly'' (35.7%) recommend the vaccine." - "Scores on the medical knowledge portion of the survey ranged from 11 to 28 correct out of a possible of 30, with a mean of 22.53 and standard deviation of 5.13." - The difference in knowledge scores between family practice, medicine, and surgery departments were significant (P 5 .017), with 65% of medical residents scoring in the top 2 score categories, 58.3% for family practice, and 27.3% for surgery." - "There was no significant difference in knowledge score based on PGY level." - "Residents who scored higher were significantly more likely to recommend strongly the influenza vaccine (P 5 .04) and be immunized (P 5 .022)." - "Among the population groups recommended by the Centers for Disease and Prevention (CDC) to receive the influenza vaccine, the greatest number of respondents (93%) recognized long-term care residents, chronic obstructive pulmonary disease patients, and individuals.50 years of age as target vaccine candidates." - "The least recognized groups reported for vaccination were second and third trimester pregnant patients and patients with anemia (60.5% and 48.8%, respectively; see Table 3)."
Martinello et al. Correlation between health care workers' knowledge of influenza vaccine and vaccine receipt. 2003	Overall 73% (154/212) persons were vaccinated. – vaccinated and correct 84% (129/154): non-vaccinated and correct 64% (37/58) - 67% (12/18) attending physicians – vaccinated and correct 92% (11/12): non-vaccinated and correct 83% (5/6) - 85% (66/78) housestaff - vaccinated and correct 83% (55/66): non-vaccinated and correct 100% (12/12) - 92% (12/13) medical students – vaccinated and correct 100% (12/12): non-vaccinated and correct 100% (1/1) - 60% (53/88) nursing – vaccinated and correct 79% (42/53): non-vaccinated and correct 54% (19/35) - 73% (11/15) patient care associate – vaccinated and correct 82% (9/11): non-vaccinated and correct 0% (0/4) - significantly more house staff were vaccinated than nursing staff - <u>nursing v physisican stratification</u>: 82% (90/109) "physicians" – vaccinated and correct 87% (78/90) : non-vaccinated and correct 95% (18/19) 80% (64/103) "nursing" – vaccinated and correct 80% (51/64): non-vaccinated and correct 49% (19/39) - The physician group was significantly more likely to be vaccinated than the nursing group - 68% of vaccinated individuals also received the influenza vaccine during the previous season

	- of those declining influenza vaccination, 66% had not been vaccinated during the previous season - Vaccine receipt during the previous season was highly correlated with current vaccine acceptance Overall 78% (166/212) persons answered all questions correctly - 89% (16/18) physicians - 86% (67/78) house staff - 100% (13/13) students - 69% (61/88) nurses - 60% (9/15) patient care assistants Subgrouping correctly answered all questions - 88% (96/109) "physicians" - 68% (70/103) "nursing" - "Thirty-six (17%) had 1 wrong answer and 10 (5%) answered 2 or more questions incorrectly." - "All 5 questions were answered correctly by 84% of vaccine recipients compared with 64% of vaccine declinees (P = .002)." - "Nursing staff who answered all 5 basic knowledge questions correctly had a significantly higher vaccination rate (80%) than did nursing staff who answered one or more of the basic knowledge questions incorrectly (49%) (P = .000005)." - "However, in the physician group, vaccination rates did not differ significantly between those who did (81%) and those who did not (92%) answer all of the basic knowledge questions correctly (P = .459)." - "Very" contagious was the response among 84% of vaccine recipients compared with 72% of vaccine declinees (P = .098)." - "A single subject of the 212 surveyed felt influenza was only "minimally" contagious." - "One or more reasons for not receiving the vaccine were provided by 52 (90%) of 58 vaccine declinees." - "Among nursing staff (n = 39), the most common reasons noted were concern that influenza vaccination will cause an influenza-like illness (17 of 39; 44%), belief that they are not at risk for influenza (6 of 39; 15%), concern regarding lack of vaccine efficacy (5 of 39; 13%), concurrent pregnancy or breast-feeding (6 of 39; 15%), and an aversion to needles (6 of 39; 15%)." - "The most common reasons for not receiving the vaccine among physicians (n = 19) were a lack of convenience (6 of 19; 32%) and "forgetfulness" (5 of 19; 26%)." - "Three (6%) of 52 subjects stated they declined influenza vaccination due to the availability of neuraminidase inhibitor medications."
Lee et al. epidemiology	- Overall, 78% of respondents indicated that they had been vaccinated against the HBV

of hepatitis b vaccine acceptance among urban paramedics and emergency medical technicians. 1997	- Of the non-vaccinated: reasons for not getting the vaccine, fear of contracting the hepatitis B virus from the vaccination (26%), vaccination scheduling difficulties (23%), not liking injections (20%), lack of time to get vaccinated (15%), fear of getting HIV from the vaccine (11%) and previous Hepatitis B infection (11%). 36% cited other reasons for not getting the vaccine "such as that the vaccine did not work or fear of potential complications from the vaccine itself". - In logistic regression: age was inversely associated with vaccine acceptance. - In logistic regression: those over age 46 were more than seven times less likely to have been vaccinated compared with those 20 to 35. - In logistic regression: EMTs were almost three times more likely not to be vaccinated compared with paramedics. - In logistic regression: officers were approximately three times more likely to have been vaccinated compared with nonofficers. - Odd ratio by age group, unadjusted and adjusted: (20-35) 1,1; (36-41) 3.00, 4.14; (42-46) 4.15, 5.66; (47-66) 6.11, 7.69 - Odd ratio by job, unadjusted and adjusted: paramedic 1,1; EMT 3.77, 2.77 - Odd ratio by rank, unadjusted and adjusted: non-officer 1,1; Officer 0.35, 0.28 - Other factors such as compliance with universal precautions (e.g., glove use), disease attitudes (e.g., perceived risk of HBV), sociodemographic characteristics (e.g., age, sex), and job characteristics (e.g., paramedic vs EMT) were evaluated for association with vaccine acceptance, but were not found to be significantly correlated.
Jacobson et al. Acceptance of Hepatitis B vaccine among dental health care workers. 1989	- Overall, 667 students, faculty and staff received all three injections. - Overall, 68.5% (667/979 ??) overall acceptance rate of vaccine - group rates for vaccine acceptance: students 93% (495/555??), faculty 50.5% (111/219??), and staff 28.7% (58/202) - students and faculty had significantly higher vaccination rates than staff - Overall, 618/979 persons returned questionnaires (63.1% response rate) - Similar response rate among each group of participants: students 59.1% (328/555), faculty 60.7% (133/219) and staff 61.9% (125/202) - Of the non-vaccinated, 67% of students (38/57), 59% of the faculty (36/61), and 88% of the staff (56/79) did not have antibodies or did not know their immunologic status. - The "at risk" population defined as those who spent more than 2 percent of their time in direct patient contact and accounts for 95.2% (n=471) of the respondents. - Of those at-risk overall, belief that severity of hepatitis B is great (96%), effectiveness of vaccine is high (88%), and susceptibility to hepatitis is high (66%) - Of those at-risk overall, barriers to vaccination: cost (25%), time (5%) - Of those at-risk overall, incentives to vaccination: 90% believe that organization and access facilitate participation, 87% believe that a motivational cue triggered vaccination - Of those at-risk overall, fear of side effects from hepatitis B vaccination was relatively low, but not zero. belief that susceptibility to side-effects are high for GBS (4%), AIDS (4%), affects on pregnancy (46%), unknown (7%)

	- Of those at-risk, vaccinated participants were more likely to feel that they were susceptible to hepatitis B, that contracting hepatitis B would have a significant effect on their lives, that the scheduled vaccination appointments were a cue or a trigger to action than non-vaccinated and that the vaccine was effective in the prevention of hepatitis B. - Of those at-risk, non-vaccinated were more likely to identify cost as a barrier to vaccination, to feel that the vaccination process (three-injection format over a six-month period of time) was time consuming, to be unsure about the accessibility of the vaccination site, and to feel that all the side effects of the vaccine were not known. - Of those at-risk, susceptibility to hepatitis B, the cost of the vaccine, the access to the vaccine, the highly structured vaccine program, the respondent's age, the motivational cue, the respondent's occupation, and beliefs about the severity of hepatitis B had significant effects upon acceptance of the vaccine. When respondents grouped by age (<26, 26-45, >45): - those older than 45 years were less likely to feel that susceptible to hepatitis is high or severity of hepatitis is great. - those <26 and those >45 were more likely to perceive that the cost of vaccination is too high - those >45 were more likely to believe that vaccination is too time consuming.
Queresh et al. Controlling varicella in health care setting: barriers to varicella vaccination among health care workers. 1999	- Overall, 2,801 HCWs underwent testing for VZV serology at the time of employment - Overall, 90/2801 (3%) were susceptible to VZV, of whom 70/90 (78%) were contacted, interviewed, and included in the study - Of the 20 non-respondents, 3 refused to be interviewed and 17 could not be contacted - Of the susceptible respondents: 53 (76%) recalled receiving written notification of their VZV serological status and an offer of VZV vaccination - of those that received an offer for vaccinination (53), 72% (38) accepted and 28% (15) refused. - Beliefs of those that received the vaccine represents only 38 people - Among those that received the vaccine % believed in the following reasons (74% desired immunity, 24% wanted to avoid infection in others, 21% followed hospital recommendation) - Beliefs of those that didn't receive the vaccine represents only 15 people - Among those that did not receive the vaccine % believed in the following reasons (33% believed it not necessary, 26% feared side effects, 20% pregnant, 20% inconvenienced) - There were no statistically significant differences in knowledge and attitudes regarding VZV and vaccine between those who did and did not receive the vaccine." - "However, of the 53 HCWs offered vaccination, 27 (71%) with direct patient care received vaccination compared to 6 (40%) of HCWs without direct patient-care responsibilities (odds ratio, 3.7; 95% confidence interval, 0.9-16; $P<.05$)."

	- "Six (53%) of the susceptible HCWs who initially declined the vaccine indicated that they would receive VZV vaccination at the time of the telephone questionnaire." - "Vaccine-associated varicella developed in 3 (8%) of the HCWs who received the vaccine; all occurred within 60 days after the first dose, were localized, were not associated with varicella exposures, and did not result in secondary cases."

Appendix C: Tdap Questionnaire and Consent

Dear UNC Health Care Employee,

The University of North Carolina is dedicated to providing excellent health care, high-quality patient service and improving the working environment at UNC Hospitals. In order to better meet your needs, please take a moment to complete this brief survey.

Your participation is entirely voluntary.

The purpose of this research study is to learn about Health Care Workers' perceptions of the pertussis vaccine. Recently, the center for disease control (CDC) and Advisory Committee on Immunization Practices (ACIP) recommended that a single dose of Tdap vaccine, which contains a pertussis component, for health-care personnel. This study will help us better understand Health Care Workers concerns about the new vaccine recommendation. You are being asked to be in the study because you are a new employee at UNC Hospitals and UNC Hospitals now requires all hospital employees to receive the Pertussis vaccine, unless you have a medical reason not to take the vaccine.

Your participation is voluntary. You are free to answer or not answer any particular question and have no obligation to complete answering the questions once you begin. Your consent to participate will be implied by completing this questionnaire.

All answers are completely confidential and all surveys are anonymous. Your answers will not affect your employment at UNC. Taking part in this research is not a part of your University duties, and refusing will not affect your job. You will not be offered or receive any special job-related consideration if you take part in this research. If you are a student, this research will not affect your class standing or grades at UNC-Chapel Hill. You will not be offered or receive any special consideration if you take part in this research.

You may contact John Jordan with any questions at (954) 599-6805 or by email (john_jordan@med.unc.edu) or Dr. David Weber at (919) 347-0639 (pager) or by email dweber@unch.unc.edu.

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

There are no right answers. We are just interested in what you think. Your opinion matters to us and we thank you for your participation.

Pertussis (Whooping Cough) Questionnaire

Section 1: Please answer the following questions, so that we may learn a little about you (Fill in the blank line or check the single box that applies)

1. What is your birth date (month/day/year)?
   ___/___/____

2. What is your sex?
   ☐ Male
   ☐ Female

3. What is your primary language?
   ☐ English
   ☐ Spanish
   ☐ Other

4. How many years in total have you worked in health care?
   _____ years

5. What is your job description?
   ☐ Physician
   ☐ Nurse
   ☐ Nurse's aid
   ☐ Technician or technologist
   ☐ Environmental services (housekeeping)
   ☐ Other Specify _____

Section 2: Some people may not be eligible for the Tdap vaccine. Please answer the following questions about your vaccination history, so that we may better understand your needs. (Fill in the blank line or check the single box that applies)

6. Have you received the new adult pertussis vaccine (Tdap)?
   ☐ Yes
   ☐ No
   ☐ Not sure

7. What is your age (in years)
   _____ years

8. When did you last receive tetanus vaccine?
   ☐ Within the past 2 years
   ☐ 2 to 5 years ago
   ☐ More than 5 years ago
   ☐ Not sure

9. Are you currently pregnant?
   ☐ Yes
   ☐ No
   ☐ Not sure

10. When you last received tetanus vaccine, did you have any serious problems?
- ☐ Yes
- ☐ No
- ☐ Not sure

Section 3: Please answer the following questions, so that we may learn a little about your previous experience with pertussis. (Check the single box that applies)

11. How is pertussis (Whooping Cough) spread between people?
- ☐ Droplet (coughing, less than 3 foot distance between people)
- ☐ Airborne (coughing, 3 or more foot distance between people)
- ☐ Direct contact (touching)
- ☐ Indirect contact (from contact with contaminated surfaces)
- ☐ Not sure

12. How many people are estimated to get pertussis (Whooping Cough) each year in the United States?
- ☐ Less than 10,000
- ☐ 10,000 to 99,999
- ☐ 100,000 to 249,999
- ☐ 250,000 to 499,999
- ☐ More than 500,000
- ☐ Not sure

13. What is the most common symptom of pertussis (Whooping Cough)?
- ☐ Cough more than 2 to 3 weeks
- ☐ Diarrhea
- ☐ Rash
- ☐ Seizures
- ☐ Not sure

14. How long are most adults sick with pertussis (Whooping Cough)?
- ☐ Less than 24 hours
- ☐ 1 to 3 days
- ☐ 4 to 7 days
- ☐ 8 to 14 days
- ☐ More than 14 days
- ☐ Not sure

15. Who gets the sickest with pertussis (Whooping Cough)?
- ☐ Infants (less than 3 months of age)
- ☐ Children (4 to 12 months of age)
- ☐ Children (1 year to 9 years of age)
- ☐ Adolescents (10 years to 16 years of age)
- ☐ Adults (more than 16 years of age)
- ☐ Not sure

16. How often do health care workers get pertussis (Whooping Cough) from working in a hospital?
- ☐ Never (has never been documented)
- ☐ Rare (a few cases have been reported in history)
- ☐ Sometimes (a few case are reported every year)
- ☐ Often (cases reported every year)
- ☐ Frequent (numerous cases are reported every year)
- ☐ Not sure

17. How often are there pertussis (Whooping Cough) outbreaks in hospitals?
- ☐ Never (has never been documented)
- ☐ Rare (a few outbreaks have been reported in history)
- ☐ Sometimes (a few outbreaks are reported every year)
- ☐ Often (outbreaks reported every year)
- ☐ Frequent (numerous outbreaks are reported every year)
- ☐ Not sure

18. North Carolina law requires pertussis (Whooping Cough) vaccine for all health care personnel (if safe)?
- ☐ Yes
- ☐ No
- ☐ Not sure

Section 4: Please review the statements below about **vaccines, in general**, and indicate how much you disagree or agree with each statement. (circle one number for each question)

19. How important are vaccines in protecting the health of the public?

Not important			Somewhat important				Very important	
1	2	3	4	5	6	7	8	9

20. Vaccination will prevent me from getting a vaccine preventable disease (like measles)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

21. Vaccination will prevent me from giving an infection to my patient (like measles)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

22. It is my responsibility to get vaccinated because I work at a hospital (if safe)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

23. Persons who work in a hospital should be required to get vaccinated (if safe)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

24. How important is it to you that UNC will pay for all vaccines given to health care workers?

Not important			Somewhat important				Very important	
1	2	3	4	5	6	7	8	9

25. How important is it to you that UNC covers you with worker's compensation if you have any problems due to vaccines given by occupational health?

Not important			Somewhat important				Very important	
1	2	3	4	5	6	7	8	9

Section 5: Please review the statements below about the **pertussis vaccine, Tdap**, and indicate how much you disagree or agree with each statement (circle one number for each question).

26. How important is the pertussis (Whooping Cough) vaccine in protecting the health of the public?

Not important			Somewhat important				Very important	
1	2	3	4	5	6	7	8	9

27. Vaccination will prevent me from getting pertussis (Whooping Cough)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

28. Vaccination will prevent me from possibily giving pertussis (Whooping Cough) to my patient?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

29. It is my responsibility to get pertussis (Whooping Cough) vaccine because I work at a hospital (if safe)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

30. Persons who work in a hospital should be required to get pertussis (Whooping Cough) vaccine (if safe)?

Strongly disagree			Neutral				Strongly Agree	
1	2	3	4	5	6	7	8	9

31. How important is it to you that UNC will pay for the pertussis (Whooping Cough) vaccine?

Not important			Somewhat important				Very important	
1	2	3	4	5	6	7	8	9

32. How important is it to you that UNC covers you with worker's compensation if you have any problems due to the pertussis (Whooping Cough) vaccine?

Not important			Somewhat important				Very important	
1	2	3	4	5	6	7	8	9

Thank you for your time in completing this questionnaire.

Please return questionnaire to designated box.

Name:	Critical Appraisal
Citation (JAMA style)	Goldstein AO, Kincade JE, Gamble G, Bearman RS.Policies and practices for improving influenza immunization rates among healthcare workers. Infect Control Hosp Epidemiol. 2004 Nov;25(11):908-11.
Question asked	What are the attitudes, policies, and barriers for requiring annual versus voluntary influenza vaccinations for the staff of healthcare institutions in North Carolina?
Intended population	Infection control individual (or the most knowledgeable person) of health care facilities in North Carolina
Research design	Cross-sectional survey. Method: telephone survey (non-anonymous)
Source Population (inclusion and exclusion)	Inclusion: Health Care Institutions (hospitals, home health agencies, nursing homes, dialysis centers, and assisted living facilities) on the statewide North Carolina list Exclusion: not one of the above, assisted living facilities housing fewer than 6 individuals, facilities housing only individuals younger than 65 Unknown: Date
Source Demographics	1316 health care institutions: - 128 hospitals, 238 home health agencies, 363 nursing homes, 92 dialysis centers, 495 assisted living facilities - Unknown: state wide distribution, average size
Study Population (inclusion and exclusion)	A 20% to 25% random sample was drawn from each group of hospitals, home health agencies, nursing homes, dialysis centers, and assisted living facilities. Inclusion: selected at random, volunteer to participate in the survey Exclusion: not selected
Study Demographics	312 total institutions - 31/128 (24.2%) hospitals - 60/238 (25.2%) home health agencies - 99/363 (27.3%) nursing homes - 23/92 (25.0%) dialysis centers - 99/495 (20.0%) assisted living facilities Among those that responded 268/312 (86%) - 30/31 (97%) hospitals - 55/60 (92%) home health agencies - 91/99 (92%) nursing homes - 19/23 (83%) dialysis centers - 70/99 (71%) assisted living facilities - Unknown: state wide distribution, average size
Method to create study groups	Voluntary vs mandated annual influenza vaccination
Comparison of groups	mandated influenza vaccination - 4% of hospitals (?1.2 out of 30) - 4% of home health (2/55)

	Voluntary measures - hospitals: 83% annual reminder, 13% other - home health agencies: 93% annual reminder, 4% other - nursing homes: 88% annual reminder, 12% other - dialysis centers: 80% annual reminder, 20% other - assisted living facilities: 86% annual reminder, 13% other
Drop outs, crossovers and adherence	44/312 (13%) non-response to 5 phone calls No further data about non-response given
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → Study (+) Study → Group (++) Good job of randomization from source to study. Volunteerism lead to a disproportionate drop-out rate affecting assisted living facilities > dialysis centers > nursing homes = home health agencies > hospitals. Self-reported grouping of mandatory vaccination policy may have lead to bias in grouping. although only a small fraction (4%) actually reported having vaccination policy.
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: telephone interviews conducted in the same manor Reliable: Validity: self-reported outcomes w/o follow-up - non-anonymous survey may produce measurement bias
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Randomization: the participants in each category were selected by randomization Restricting: population was restricted to hospitals, home health agencies, nursing homes, dialysis centers, and assisted living facilities in North Carolina, excluding assisted living facilities housing fewer than 6 individuals, facilities housing only individuals younger than 65 Others: - no information collected on actual rates of influenza immunization, although unlikely to be different than the rest of the nation. - Risk managers serve as representative for the health care workers of that facility. Although this is a better estimation of health care worker attitudes and beliefs than a survey of non-health care professionals, this perspectives expressed in this survey of representatives is probably only applicable to health care workers of higher SES/management than the majority of health care workers because the managers probably don't have frequent communication with all health care workers regarding influenza vaccination.
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	Data were analyzed with descriptive and chi-square statistics using SPSS software (version 11.0; SPSS, Inc., Chicago, IL)

	survey included questions regarding written policies on annual influenza vaccinations for employees, policy implementation practices, staff incentives to encourage immunizations, institutional support for a policy of mandatory annual influenza vaccinations for at-risk workers, potential barriers to employee vaccinations, and support for a state law that would mandate influenza immunizations for employees with patient care contact.
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	- Overall, 38% of institutions have formal written polities regarding employee influenza vaccination - institutions with formal written policy: 70% hospitals, 49% home health, 44% nursing homes, 26% dialysis centers, 14% assisted living - the rest either no written policy or unsure if a policy existed. - Hospitals were significantly more likely to have written employee influenza policies than other institutions - assisted living centers were significantly less likely to have written polities than other institutions. - Of those that had written policies, 2% have mandatory annual influenza vaccinations - Of those that had written policies, institutions with mandatory annual influenza vaccination: 4% hospitals, 4% home health. - the rest no mandatory requirement - Of those that had written policies, 88% of the institutions reported relying on voluntary measures such as annual reminders to implement their policies - Of those that had written policies, 88% of institutions had annual reminders - Of those that had written policies, 69% reported having free vaccinations as a mechanism to encourage employee vaccination - Of those that had written policies, 52% reported having educational efforts as a mechanism to encourage empoloyee vaccination - Of those that had written policies, 32% reported having low-cost vaccines as a mechanism to encourage empoloyee vaccination - Of those that had written policies, 13% reported having vaccination drives as a mechanism to encourage empoloyee vaccination - Of those that had written policies, voluntary measures: hospitals: 83% annual reminder, 13% other; home health agencies: 93% annual reminder, 4% other; nursing homes: 88% annual reminder, 12% other; dialysis centers: 80% annual reminder, 20% other; assisted living facilities: 86% annual reminder, 13% other - assisted living centers were 3 times less likely to offer free influenza vaccinations compared with other institutions ($p<0.001$) - Hospitals and nursing homes reported using educational efforts significantly more often than home health agencies, dialysis centers, or assisted living facilities. ($p<0.001$) - Overall, reported barriers to receiving vaccination: "fear of side effects" (68%), "perceived ineffectivenss of vaccine"(53%), "fear of needles" (26%), "enforcing the policy" (11%), "money issues" (7%) and other (36%). - barriers to receiving vaccination by institution: Hospital - "fear of side effects" (77%), "perceived ineffectivenss of vaccine"(67%), "enforcing the policy" (21%), "money issues" (3%) and other (43%). Home Health - "fear of side effects" (65%), "perceived ineffectivenss of vaccine"(43%), "enforcing the policy" (2%), "money issues" (2%) and other (13%). Nursing Home - "fear of side effects" (74%), "perceived ineffectivenss of vaccine"(48%), "enforcing the policy" (21%), "money issues" (3%) and other (52%).

	Dialysis center - "fear of side effects" (79%), "perceived ineffectivenss of vaccine"(42%), "enforcing the policy" (0%), "money issues" (0%) and other (26%). Assisted living- "fear of side effects" (57%), "perceived ineffectivenss of vaccine"(66%), "enforcing the policy" (4%), "money issues" (19%) and other (31%). - Overall, 40% of the respondents indicated support for statewide laws mandating influenza vaccinations for all HCWs with direct patient contact - Overall, 49% of the respondents indicated support for facility-wide regulations mandating influenza vaccinations for all HCWs with direct patient contact - Of those not supporting a state law, 61% felt that the decision should be a personal one - Of those not supporting a state law, 48% felt that that such immunizations should not be mandated - Of those not supporting a state law, 24% felt that the law would not work - Of those not supporting a state law, 5% felt that the law would be too difficult to administer.
Internal validity	Good: well designed study with conclusions that can be applied to intended population
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, The source population of North Carolina is a convenience sample of all Health Care Workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Nichol KL, Hauge M.Influenza vaccination of healthcare workers.Infect Control Hosp Epidemiol. 1997 Mar;18(3):189-94.
Question asked	What factors are associated with influenza vaccination of health care workers
Intended population	Health care workers in U.S.
Research design	Cross-sectional survey. Method: mailed survey (anonymous)
Source Population (inclusion and exclusion)	Inclusion: Health care workers (Staff physicians and nurses), employed by Minneapolis University-affiliated veterans affairs, during late spring and early summer 1994 Exclusion: not included above
Source Demographics	1031 total - Unknown: age, sex, race, SES, occupation
Study Population (inclusion and exclusion)	Inclusion: All Exclusion: none
Study Demographics	1031 total persons Among those that responded 392/1031 (38%) - Mean age 43.6 years - 71.5% were female - 26.2% were physicians - Unknown: race, SES
Method to create study groups	Self-reported: vaccination vs non-vaccinated
Comparison of groups	Vaccine recipients 240/392 (61.2%) Mean age of respondents 45.4 years - 66.8% were female - 33.8% were physicians Vaccine non-recipients 152/392 (38.7%) Mean age of respondents 40.3 years - 78.3% were female - 14.6% were physicians
Drop outs, crossovers and adherence	639/1031 (62%) non-response to single survey
Potential for selection bias (+ to +++)	Source→ study (n/a) Study→groups (++)

Source → Study Study → Groups	Selection bias is not applicable from source to study b/c all subjects were included. No data described differences between respondents and non-respondents. Therefore, effects of volunteerism cannot be assessed. Study groups were created by self-reported status. Therefore, selection bias may have occurred.
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: same survey to all participants Reliable: Validity: self-reported outcomes w/o follow-up
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: Health care workers (Staff physicians and nurses), employed by Minneapolis University-affiliated veterans affairs, during late spring and early summer 1994 Controlling: work setting, contact w/ elderly, contact w/ high-risk patients, previous immunization Overall - 60.8% work in inpatient setting, 15.1% work in outpatient setting, 24.2% work in both - more than 96.1% of practitioners had daily or weekly contact with elderly paitents. - more than 96.6% of practitioners had daily or weekly contact with high-risk patients - 60.8% had been immunized to influenza during the previous winter. Vaccine recipients - 50.9% work in inpatient setting, 19.0% work in outpatient setting, 30.2% work in both - more than 95.8% of practitioners had daily or weekly contact with elderly paitents. - more than 96.2% of practitioners had daily or weekly contact with high-risk patients Non-recipients - 75.2% work in inpatient setting, 8.7% work in outpatient setting, 16.1% work in both - more than 96.7% of practitioners had daily or weekly contact with elderly paitents. - more than 97.3% of practitioners had daily or weekly contact with high-risk patients Other: Motivators: - employees are encouraged to receive vaccination through the outpatient clinic. - Mobile vaccination carts provide accesability to health care workers in clinic or ward areas.
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat	Univariate comparison were conducted using chi-square tests for categorical variables and student's t-test for continuous variables (epi info, version6,

or other adjustment)	cdc, Atlanta, ga). Stepwise logistic regression (spss 6.1 for windows, spss, Chicago, IL) was used to identify those factors independently associated with receipt of influenza vaccine while controlling for covariates and potential confounders. Variables that significantly differed between vaccine recipients and nonrecipients in bivariate comparisons were considered for inclusion in the model; all variables except age were re-coded as dichotomous variables to facilitate interpretation using odds rations.
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	- Overall, the response rate was 38.0% (392/1031) - overall, mean age of respondents was 43.6 years - overall, 71.5% were female - overall, 26.2% were physicians." Overall - 67.1% were vaccinated > or = 1 time in the preceding 5 years - 67.4% intended to be vaccinated next year - 95.5% recommend vaccination to high-risk patients Vaccine recipients - 86.4% were vaccinated > or = 1 time in the preceding 5 years - 96.2% intended to be vaccinated next year - 97.4% recommend vaccination to high-risk patients Non-recipients - 39.5% were vaccinated > or = 1 time in the preceding 5 years - 21.5% intended to be vaccinated next year - 92.3% recommend vaccination to high-risk patients - Vaccine recipients were found to be significantly older than non-recipients (45.4 v. 40.3), more likely to be a physician (33.6% v. v 14.6%), more likely to have been vaccinated in the preceding 5 years (86.4% v 39.5%) and more likely to intend to be vaccinated next year (96.2% v 21.5%). - among vaccine recipients persons who ranked each variable as very high were "not wanting to get sick" (82.5%), "protecting patients" (61.7%), "convenience" (68.3%), "free vaccine" (58.3%), "national recommendations" (25%), and "physicians recommendation" (7.9%). - among non-recipients persons who ranked each variable as very high were "concern about side effects" (36.2%), "not in target group" (14.5%), "inconvenience" (9.9%), "disagree with recommendations" (9.9%), "do not have contact with high-risk patients" (5.9%), "don't like needles" (5.3%), "forgot" (4.6%), and "cost"(0.7%). - Vaccine recipients were significantly more likely than were vaccine nonrecepients to indicate that influenza and its complications are very serious for high-risk patients, that the vaccine is very effective, that influenza vaccination is uncommonly associated with side effects, that healthcare workers' risk for contracting influenza is higher than the general public's risk, and that it is very important for healthcare workers to receive the vaccine to decrease

	risk for transmission to high-risk patients. - stepwise regression reveals "previous receipt of infleuzna vaccine" (5.4 OR), "annual influenza vaccinations for health care workers considered very important for the protections of patients" (4.9 OR), "physician (versus RN or LPN)" (2.2 OR), "Influenza vaccine considered to be very effective" (2.2 OR), " influenza vaccination considered to be associated with systemic side effects in <1% of recipeients" (2.0 OR), and age (1.04 OR for each increasing year).
Internal validity	Good: well designed study with conclusions that can be applied to intended population
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of the Minniapolis University affiliated VA is a convenience sample of all health care workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Weingarten S, Riedinger M, Bolton LB, Miles P, Ault M. Barriers to influenza vaccine acceptance. A survey of physicians and nurses. Am J Infect Control. 1989 Aug;17(4):202-7.
Question asked	What are the attitudes and behavior of health care providers concerning influenza and influenza immunization for the development of an effective immunization program.
Intended population	Health care workers in the U.S.
Research design	Cross-sectional survey. Method: mailed survey (non-anonymous)
Source Population (inclusion and exclusion)	Inclusion: House staff members and fellows in medicine, surgery, obstetrics and gynecology, and pediatrics) at Cedars-Sinai Medical Center in February of 1987 and Questionnaires also were sent to a 25% random sample of full-time nursing personnel at Cedars-Sinai Medical Center in February of 1987 chosen from an employee roster. In addition, a duplicate questionnaire was given to a sample of nurses and all house staff members Exclusion: per diem nurses
Source Demographics	463 total House staff members and fellows in medicine, surgery, obstetrics and gynecology, and pediatrics received a survey form (n = 180) full-time nursing personnel (n = 283). - Unknown: age, sex, race, SES
Study Population (inclusion and exclusion)	Inclusion: All Exclusion: Nurses and physicians who reported that they did not have patient contact
Study Demographics	463 total persons Among those that responded 193/463 (41%) - 85/180 (47%) of physicians, 108/283 (38%) of nursing personnel - Unknown: age, sex, race, SES Study group consisted of: - 85 (44%) physicians, 108 (56%) nursing personnel - 70 (36.3%) men, 123 (63.7%) women - Unknown: age, race, SES
Method to create study groups	Self reported: vaccination vs non-vaccination
Comparison of groups	No further data given
Drop outs, crossovers and adherence	270/463 (58.3%) non-response after providing the survey twice
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → study (++) Study → group (++) Selection bias may have occurred among the random sample of the full-time nursing personnel. Additional selection bias may have occurred with the recruitment through the duplicate questionnaire which was analyzed together with initial

	surveys. Limited data describing differences between respondents and non-respondents. Therefore, effects of volunteerism cannot be assessed. Study groups were created by self-reported status. Therefore, selection bias may have occurred.
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: same survey to all participants Reliable: 10% of nonresponders were sampled and believed to be very similar to responders. Validity: self-reported outcomes w/o follow-up - non-anonymous nature may produce measurement bias
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: House staff members and fellows in medicine, surgery, obstetrics and gynecology, and pediatrics) at Cedars-Sinai Medical Center in February of 1987 and Questionnaires also were sent to a 25% random sample of full-time nursing personnel at Cedars-Sinai Medical Center in February of 1987 chosen from an employee roster. Exclusion: per diem nurses and subjects who reported that they did not have patient contact Others: - the directed follow up survey of non-responders may have affected outcome. <u>Motivators</u> (-) There were no policies or formal educational programs regarding influenza immunization for hospital staff members (+) A hospital newsletter, however, did report indications for and the importance of influenza immunization. (+) Influenza vaccine was available for health care providers at the employee health service. (+) Influenza immunization was available to hospital employees at a charge of approximately $5.00 per vaccine. (-) There was no official endorsement either by the employee health service or by the infection control committee regarding the use of the vaccine. (+) Survey was distributed 3 weeks after the conclusion of known influenza activity at our hospital,
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	All questions had yes/no answer format Comparison of the responses of nurses, physicians, responders, and nonresponders was performed with the use of the chi-square statistic with Yates' correction or the Fisher's exact test. - (1) demography, (2) the occurrence of influenza-like illness, (3) influenza vaccine compliance, (4) amantadine use, (5) reasons for working with an influenza-like illness, (6)reasons for refusing the influenza vaccine, and (7) suggestions for improving future immunization compliance.
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	- 41.1% (193/463) response rate. - 5% of subjects reported using either a monovalent or trivalent influenza vaccine - 4.2% of subjects reported using amantadine chemoprophylaxis - 35% reported having an influenza like illness during the period of documented influenza activity in the hospital

	- 77% reported that they took care of patients while having an illness. - reasons to decline immunization "avoid medications whenever possible" (59%), "vaccine administration inconvenient" (31%), "concerned about a severe reaction" (29%), "concern about getting influenza from the vaccine" (25%), "vaccine ineffective" (24%), "concern about the pain" (12%), "prior adverse reaction to the vaccine" (5%), "vaccine too expensive" (5%), and "allergic to vaccine" (1%). - Nurses were more likely to report "avoid medications whenever possible" (71% vs 42%), "concerned about a severe reaction" (42% vs 12%), "concern about getting influenza from the vaccine" (40% vs 7%), "vaccine ineffective" (38% vs 8%) and "concern about the pain" (17% vs 5%) than physicians as a reason to decline immunization. ($p < 0.05$) - ways to make vaccination more acceptable the following year "if it were a national health care policy" (73%), "if the vaccine had little risk" (55%), "if immunization were more convenient" (53%), and "if the vaccine were free" (47%). - Nurses were more likely to report "if the vaccine had little risk" (66% vs 41%) than physicians as a way to make vaccination more acceptable the following year. ($p < 0.05$) - reasons why they worked while sick "did not want others to perform the work" (78%), "not sick enough to stay home"(65%), "had important work to be done that day" (60%), "did not want to use sick time" (24%), and "no sick time left" (9%). - Nurses were more likely to report "no sick time left" (19% vs 0%) than physicians as a reason to work while sick. ($p < 0.05$) - Physicians were more likely to report "did not want others to perform the work" (90% vs 65%) and "had important work to be done that day (90% vs 29%) than nurses as a reason to work while sick. ($p < 0.05$)
Internal validity	Good: well designed study with conclusions that can be applied to intended population
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of the Cedars-Sinai Medical Center is a convenience sample of all Health Care Workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Toy WC, Janosky JE, Laird SB.Influenza immunization of medical residents: knowledge, attitudes, and behaviors.Am J Infect Control. 2005 Oct;33(8):473-5.
Question asked	What are the attitudes health beliefs and medical knowledge of medical residents related to influenza immunization
Intended population	Resident Physicians in the U.S.
Research design	Cross-sectional survey. Method: paper based survey (anonymous) collected at same meeting
Source Population (inclusion and exclusion)	Inclusion: Internal Medicine, Family medicine and surgery residents at Western Pennsylvania Hospital, from January to February 2004 Exclusion: not included above
Source Demographics	43 total - Unknown: age, sex, race, SES, occupation
Study Population (inclusion and exclusion)	Inclusion: attending general resident meetings Exclusion: none
Study Demographics	43 total persons Among those that responded 43/43 (100%) - 53.5% were male - 51.2% were international medical graduates. - 55.8% aged 18 to 29, 39.5% aged 30 to 39 - 45.2% were First year residents, 28.6% were 2nd year, 21.4% were third year, 4.8% and fifth year - Unknown: race
Method to create study groups	Self-reported: vaccination vs non-vaccination
Comparison of groups	58% of the respondents reported receiving the vaccine. - 67% of family medicine, 60% of internal medicine, and 45.5% of surgery - No further comparison of vaccinated and non-vaccinated
Drop outs, crossovers and adherence	Not stated, but assumed to be 100%
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → study (+) Study → group (++) Selection bias may have occurred if residents were absent from the meeting, which survey was distributed. No data described differences between respondents and non-respondents. Therefore, effects of volunteerism cannot be assessed. Study groups were created by self-reported status. Therefore, selection bias may have occurred.
Equal, reliable, valid measurements (intervention/exposure,	Equal: same survey to all participants Reliable: Validity: self-reported outcomes w/o follow-up

outcome)	
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: Internal Medicine, Family medicine and surgery residents at Western Pennsylvania Hospital, from January to February 2004 and attending the meeting that survey was distributed Others - 97.6% of the residents reported excellent to good health - 25.6% reported having kids < 16 years of age. - questionnaire designed specifically for this study was used to collect demographic, health beliefs and attitudes, and medical knowledge data relative to the influenza vaccine Motivators: - free vaccine - 91% believed vaccination was convenient
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	The compliance with vaccination was analyzed in relation to potential predictors. Continuous prediction variables of interest were analyzed using analysis of variance with Scheffe's post hoc test when appropriate. Categorical variables of interest were analyzed using x_2 or Fisher exact test. Statistical significance was defined as P,.05. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 11.0 for Windows (SPSS, Inc. Chicago, IL).
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	- Overall, influenza vaccination was 58.1% (67% of family medicine, 60% of internal medicine, and 45.5% of surgery, not significant difference). - Resident influenza immunization rate in this sample was higher than the national average for healthcare workers. - Most of the residents fell between 2 age groups: 18 to 29 (55.8%) years of age and 30 to 39 (39.5%) years of age. - First year residents composed 45.2% of the respondents, second year 28.6%, third year 21.4%, and fifth year 4.8%. -- 97.6% of the residents reported excellent to good health - 25.6% (11/43) residents reported having kids ,<16 years of age - 91% of the residents knew that the vaccine was being offered for free - 92% of the residents believed that receiving the vaccine was convenient. - 95.3% of residents would recommend the vaccine to others. - Immunization rates were significantly associated with postgraduate level, prior vaccination, media influence, whether they knew co-residents who were vaccinated, medical knowledge scores, and plan to be vaccinated next year.

	- The percentage of vaccine recipients within the medical specialty departments was 66.7% of family practice residents, 60.0% of internal medicine residents, and 45.5% of surgery residents. - However, the immunization rates by departments were not significantly different. - A significant difference in immunization rates by postgraduate year was found, with PGY-1 at 47.4%, PGY-2 at 50%, and PGY-3 at 100%. - 86% of the residents knew co-residents who were vaccinated, which was found to be a significant predictor of immunization rates. - 61% of respondents reported prior influenza vaccination, which was found to be a significant predictor of plans to be immunized in the future. - 81% of residents reported that they plan to get the influenza vaccine next season, which was significantly higher among the respondents who received the vaccine this year. - "The media were determined to be a significant factor positively influencing a resident's decision to be vaccinated (P # .001)." - "All of the 5 residents who reported being influenced in their decision to be vaccinated by the media received the vaccine." - "Immunization rates by age, sex, type of medical school (international/United States), whether or not they had children under age of 16 years, whether or not they would recommend the vaccine to patients, and the respondents' health status were not significant." - Numerous reasons for getting vaccinated were cited by those who received the vaccine including: "at risk because of their work" (80%), "risking transmission to patients" (68%), "influenza vaccine generally safe" (56%), "influenza vaccine is effective" (36%), "flu is a serious disease" (28%), "encouraged by other employees" (24%), "chronic illness" (4%). - 18 residents (41.9%) did not receive the influenza vaccine and their reasons are as follows: "procrastinated/forgot" (44%), "not interested" (16.7%), "not in high-risk group" (16.7%), "not likely to get flu" (16.7%), "vaccine is not effective" (11.1%), "do not like needles"(11.1%), "concern about adverse effects" (11.1%), "concern about pain/discomfort" (11.1%), "flu is not a serious disease" (11.1%), "did not know it was available" (5.6%), "allergic to the vaccine" (5.6%). - "In terms of recommending the influenza vaccine to resistant patients, most of the residents would either ''most likely'' (54.8%) or ''very strongly'' (35.7%) recommend the vaccine." - "Scores on the medical knowledge portion of the survey ranged from 11 to 28 correct out of a possible of 30, with a mean of 22.53 and standard deviation of 5.13." - The difference in knowledge scores between family practice, medicine, and surgery departments were significant (P 5 .017), with 65% of medical residents scoring in the top 2 score categories, 58.3% for family practice, and 27.3% for surgery." - "There was no significant difference in knowledge score based on PGY level." - "Residents who scored higher were significantly more likely to recommend strongly the influenza vaccine (P 5 .04) and be immunized (P 5 .022)." - "Among the population groups recommended by the Centers for Disease and Prevention (CDC) to receive the influenza vaccine, the greatest number of

	respondents (93%) recognized long-term care residents, chronic obstructive pulmonary disease patients, and individuals.50 years of age as target vaccine candidates." - "The least recognized groups reported for vaccination were second and third trimester pregnant patients and patients with anemia (60.5% and 48.8%, respectively; see Table 3)."
Internal validity	Fair: study does not have any major flaws with conclusions that should be interpreted with caution - very small subgroups (25 subjects vaccinated and 18 subjects not vaccinated)
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of the Western Pennsylvania Hospital is a convenience sample of all Health Care Workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Martinello RA, Jones L, Topal JE.Correlation between healthcare workers' knowledge of influenza vaccine and vaccine receiptInfect Control Hosp Epidemiol. 2003 Nov;24(11):845-7.
Question asked	Are beliefs in commonly held influenza vaccine misconceptions associated with influenza vaccine acceptance?
Intended population	Health care workers in the US.
Research design	Cross-sectional survey. Method: paper based survey (non-anonymous)
Source Population (inclusion and exclusion)	Inclusion: Health care workers (nursing staff, internal medicine and pediatrics house staff, attending physicians, and medical students) at Yale–New Haven Hospital from December 2000 through March 2001 Exclusion: not included above
Source Demographics	215 total - Unknown: age, sex, race, SES, occupation
Study Population (inclusion and exclusion)	Inclusion: All Exclusion: none
Study Demographics	215 total persons Among those that responded (212/215) - median age of the subjects was 30 years (range, 22 to 64 years) - 69% were female. - 18 were physicians, 78 were housestaff, 13 were medical students, 88 were nurses, 15 were patient care assistants - Unknown: race, SES
Method to create study groups	Self-reported: Vaccination vs non-vaccination
Comparison of groups	Overall 73% (154/212) persons were vaccinated. – vaccinated and correct 84% (129/154): non-vaccinated and correct 64% (37/58) - 67% (12/18) attending physicians – vaccinated and correct 92% (11/12): non-vaccinated and correct 83% (5/6) - 85% (66/78) housestaff - vaccinated and correct 83% (55/66): non-vaccinated and correct 100% (12/12) - 92% (12/13) medical students – vaccinated and correct 100% (12/12): non-vaccinated and correct 100% (1/1) - 60% (53/88) nursing – vaccinated and correct 79% (42/53): non-vaccinated and correct 54% (19/35) - 73% (11/15) patient care associate – vaccinated and correct 82% (9/11): non-vaccinated and correct 0% (0/4) Subgrouping 82% (90/109) "physicians" – vaccinated and correct 87% (78/90) : non-vaccinated and correct 95% (18/19) 80% (64/103) "nursing" – vaccinated and correct 80% (51/64): non-vaccinated and correct 49% (19/39) Overall 78% (166/212) persons answered all questions correctly - 89% (16/18) physicians - 86% (67/78) house staff - 100% (13/13) students

	- 69% (61/88) nurses - 60% (9/15) patient care assistants Subgrouping - 88% (96/109) "physicians" - 68% (70/103) "nursing"
Drop outs, crossovers and adherence	3/215 (1%) non-response to single survey No further data about non response given
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → Study (n/a) Study → group (++) Selection bias is not applicable from source to study b/c all subjects were included. No data described differences between respondents and non-respondents. Therefore, effects of volunteerism cannot be assessed. However, small (1% drop-out) Study groups were created by self-reported status. Therefore, selection bias may have occurred.
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: same survey to all participants Reliable: Validity: self-reported outcomes w/o follow-up - only 44% of staff were vaccinated by OHS - Identifiers were included in the demographic information to reduce duplication of responses (non-anonymous nature may produce measurement bias)
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: nursing staff, internal medicine and pediatrics house staff, attending physicians, and medical students at Yale–New Haven Hospital from December 2000 through March 2001 Controling: Others: - For further statistical analysis, subjects were aggregated into two groups: nursing (patient care associates, licensed practical nurses, and registered nurses) and physicians (attending physicians, house staff, and medical students). - analysis aggregated data into groupings of those who got all 5 questions right (n=166) and those who did not (36 had 1 question wrong and 10 had 2 or more incorrect). Motivators: - Influenza vaccination was provided free of charge

	- Vaccination was made conveniently available at patient care areas and Occupational Health Service - Education about the influenza vaccine and its importance occurred through in-service and noon conferences
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	- Chi-square or Fisher's exact test was used to compare categorical data and the Wilcoxon rank sum test was used for continuous variables with SAS software (version6.12; SAS Institute, Inc., Cary, NC). All statistics were two-tailed. *P* values of .05 or less were considered significant. - Comparison of rates of vaccination for each occupation were compared as separate groupings. - 5 questions focusing on common misconceptions about influenza vaccine - prompted with 10 potential reasons for vaccine declination and additional written responses were encouraged. - questioned regarding vaccine receipt during the previous year and whether they felt influenza is "very," "somewhat," or "minimally" contagious.
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	Overall 73% (154/212) persons were vaccinated. - 67% (12/18) attending physicians – vaccinated and correct 92% (11/12): non-vaccinated and correct 83% (5/6) - 85% (66/78) housestaff - vaccinated and correct 83% (55/66): non-vaccinated and correct 100% (12/12) - 92% (12/13) medical students – vaccinated and correct 100% (12/12): non-vaccinated and correct 100% (1/1) - 60% (53/88) nursing – vaccinated and correct 79% (42/53): non-vaccinated and correct 54% (19/35) - 73% (11/15) patient care associate – vaccinated and correct 82% (9/11): non-vaccinated and correct 0% (0/4) – vaccinated and correct 84% (129/154): non-vaccinated and correct 64% (37/58) - significantly more house staff were vaccinated than nursing staff - <u>nursing v physisican stratification</u>: 82% (90/109) "physicians" – vaccinated and correct 87% (78/90) : non-vaccinated and correct 95% (18/19) 80% (64/103) "nursing" – vaccinated and correct 80% (51/64): non-vaccinated and correct 49% (19/39) - The physician group was significantly more likely to be vaccinated than the nursing group - 68% of vaccinated individuals also received the influenza vaccine during the previous season - of those declining influenza vaccination, 66% had not been vaccinated during the previous season - Vaccine receipt during the previous season was highly correlated with current vaccine acceptance Overall 78% (166/212) persons answered all questions correctly - 89% (16/18) physicians - 86% (67/78) house staff - 100% (13/13) students - 69% (61/88) nurses - 60% (9/15) patient care assistants

	Subgrouping - 88% (96/109) "physicians" - 68% (70/103) "nursing" - "Thirty-six (17%) had 1 wrong answer and 10 (5%) answered 2 or more questions incorrectly." - "All 5 questions were answered correctly by 84% of vaccine recipients compared with 64% of vaccine declinees (P = .002)." - "Nursing staff who answered all 5 basic knowledge questions correctly had a significantly higher vaccination rate (80%) than did nursing staff who answered one or more of the basic knowledge questions incorrectly (49%) (P = .000005)." - "However, in the physician group, vaccination rates did not differ significantly between those who did (81%) and those who did not (92%) answer all of the basic knowledge questions correctly (P = .459)." - "Very" contagious was the response among 84% of vaccine recipients compared with 72% of vaccine declinees (P = .098)." - "A single subject of the 212 surveyed felt influenza was only "minimally" contagious." - "One or more reasons for not receiving the vaccine were provided by 52 (90%) of 58 vaccine declinees." - "Among nursing staff (n = 39), the most common reasons noted were concern that influenza vaccination will cause an influenza-like illness (17 of 39; 44%), belief that they are not at risk for influenza (6 of 39; 15%), concern regarding lack of vaccine efficacy (5 of 39; 13%), concurrent pregnancy or breast-feeding (6 of 39; 15%), and an aversion to needles (6 of 39; 15%)." - "The most common reasons for not receiving the vaccine among physicians (n = 19) were a lack of convenience (6 of 19; 32%) and "forgetfulness" (5 of 19; 26%)." - "Three (6%) of 52 subjects stated they declined influenza vaccination due to the availability of neuraminidase inhibitor medications."
Internal validity	Fair: study does not have any major flaws with conclusions that should be interpreted with caution - Most statistical analysis performed on aggregate data of "nurses" vs "physicians"
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of Yale-New Haven Hospital is a convenience sample of all health care workers in the U.S..

Name:	Critical Appraisal
Citation (JAMA style)	Lee DJ, Carrillo L, Fleming L. Epidemiology of hepatitis B vaccine acceptance among urban paramedics and emergency medical technicians. Am J Infect Control. 1997 Oct;25(5):421-3..
Question(s) asked	What is the epidemiology of hepatitis B vaccine acceptance or rejection among paramedics and EMT?
Intended population	Paramedics and EMT in U.S.
Research design	Cross-sectional survey. Method: mailed survey (anonymous)
Source Population (inclusion and exclusion)	Inclusion: Fire rescue personnel (paramedics and emergency medical technicians), employed during 1994 in a single large urban fire rescue department in Southeastern U.S. Exclusion: not included above
Source Demographics	1250 persons - Unknown: age, sex, race, SES, occupation breakdown.
Study Population (inclusion and exclusion)	Inclusion: all included Exclusion: individuals who participated in no fire rescue calls in the previous 30 days, who were neither paramedics nor EMTs, or who failed to answer the questions pertaining to HBV vaccination (total meeting exclusion criteria 41)
Study Demographics	1250 total persons Among those that responded 296/1250 (24%) 255/1250 (20.4%) meet inclusion and exclusion criteria 92% male Average age 41 69% white, 22% hispanic, 6% black 21% obtained a bachelors degree - Unknown: occupation breakdown
Method to create study groups	Self reported vaccination status
Comparison of groups	199/255 (78%) vaccinated - of the age group: (20-35) 59/64 = 92%; (36-41) 67/79 = 85%; (42-46) 69/85 = 81%; (47-66) 52/68 = 76% - of the occupation: paramedic 146/162 = 90%; EMT 101/133 = 76% - of the ranking: non-officer 144/181= 80%; Officer 103/114 = 90% 56/255 (22%) non-vaccinated - of the age group: (20-35) 4/64 = 8%; (36-41) 12/79 = 15%; (42-46) 16/85 = 19%; (47-66) 16/68 = 24% - of the occupation: paramedic 16/162 = 10%; EMT 32/133 = 24% - of the ranking: non-officer 37/181= 20%; Officer 11/114 = 10%
Drop outs, crossovers and adherence	954/1250 (76%) non-response to single mailing No further information about non-response
Potential for selection bias (+ to +++)	Source → Study (n/a) Study → groups (++)

Source → Study Study → Groups	Selection bias is not applicable from source to study b/c all subjects were included. Although 41 respondents were excluded after the survey was returned, it is unknown how this may bias entry to the study group. No data described differences between respondents and non-respondents. Therefore, effects of volunteerism cannot be assessed. Study groups were created by self-reported status. Therefore, selection bias may have occurred.
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: same survey to all participants Reliable: - Pre-tested on 5 fire rescue personnel and revised. Then administered to 23 paramedics and EMTs and readministered 3 days later. Test-retest reliability, assessed by the Kappa test, indicated good to excellent reliability for most questionnaire items. The Kappa estimate for the question, "Have you been vaccinated against the Hepatitis B virus," was 0.89. - "a follow-up sub-study of 44 paramedics and EMTs randomly selected from the same fire department found no differences between original survey responders and non-responders with respect to the number of exposures to blood, use of universal precautions, and perceived risk of occupational infection." Validity: self-reported outcomes w/o follow-up
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: Fire rescue personnel (paramedics and emergency medical technicians), employed during 1994 in a single large urban fire rescue department in Southeastern U.S., excluding individuals who participated in no fire rescue calls in the previous 30 days, who were neither paramedics nor EMTs, or who failed to answer the questions pertaining to HBV vaccination Controling: compliance with universal precautions, disease attitudes, sociodemographic characteristics and occupation. Other - Considered those who have had hepatitis B with those who are not vaccinated Motivators: none
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	Backward logistic regression was used to identify correlates of hepatitis vaccine acceptance. A two-stage process was used to obtain the final model. First, four separate backward logistic regression models were generated predicting vaccine uptake by use of variables grouped in the following categories: compliance with universal precautions (e.g., glove use), disease attitudes (e.g., perceived risk of HBV), sociodemographic characteristics (e.g., age, sex), and job characteristics (e.g., paramedic vs EMT). Variables that were significant in these four analyses were then entered into a final logistic regression model. - the backward logistic regression did not evaluate history of blood exposures as a risk factor for hepatitis vaccination.
Results: magnitude and direction (point estimate; random error or	- Overall, 78% of respondents indicated that they had been vaccinated against the HBV

precision (confidence interval); statistical significance	- Of the non-vaccinated: reasons for not getting the vaccine, fear of contracting the hepatitis B virus from the vaccination (26%), vaccination scheduling difficulties (23%), not liking injections (20%), lack of time to get vaccinated (15%), fear of getting HIV from the vaccine (11%) and previous Hepatitis B infection (11%). 36% cited other reasons for not getting the vaccine "such as that the vaccine did not work or fear of potential complications from the vaccine itself". - In logistic regression: age was inversely associated with vaccine acceptance. - In logistic regression: those over age 46 were more than seven times less likely to have been vaccinated compared with those 20 to 35. - In logistic regression: EMTs were almost three times more likely not to be vaccinated compared with paramedics. - In logistic regression: officers were approximately three times more likely to have been vaccinated compared with nonofficers. - Odd ratio by age group, unadjusted and adjusted: (20-35) 1,1; (36-41) 3.00, 4.14; (42-46) 4.15, 5.66; (47-66) 6.11, 7.69 - Odd ratio by job, unadjusted and adjusted: paramedic 1,1; EMT 3.77, 2.77 - Odd ratio by rank, unadjusted and adjusted: non-officer 1,1; Officer 0.35, 0.28
Internal validity	Fair: study does not have any major flaws with conclusions that should be interpreted with caution - considered those who have had hepatitis B in with those who reported not to have vaccine. - the backward logistic regression did not evaluate history of blood exposures as a predictor for hepatitis vaccination.
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of a single large urban fire rescue department in Southeastern U.S. is a convenience sample of all Health Care Workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Jacobson JJ, Lang WP, Ybanez MS, Shipman C Jr, Johnston FK, LaTurno DE.Acceptance of hepatitis B vaccine among dental health care workers.J Public Health Dent. 1989 Spring;49(2):67-72.
Question asked	What are the characteristics associated with participation in Hepatitis B vaccination and non-participation among Dental Health Care Workers
Intended population	Dental Health Care Workers (DHCW) in the U.S.
Research design	Cross-sectional survey. Method: mailed survey (anonymous)
Source Population (inclusion and exclusion)	Inclusion: All faculty (clinical and research), students (dental, dental hygiene and graduate), and staff (auxillaries, administrators, secretaries and support personnel), at the University of Michigan School of dentistry between Sept 1984 to February 1985. Exclusion: not mentioned above
Source Demographics	976 total persons - 555 students, 219 faculty, 202 staff - Unknown: age, sex, race, SES
Study Population (inclusion and exclusion)	All included None excluded
Study Demographics	976 total persons Among those that responded 586/976 (60%) - 328/555 (59%) students - 133/219 (61%) faculty - 125/202 (62%) staff - Unknown: age, sex, race, SES
Method to create study groups	Program records of complete vaccination vs non-vaccination
Comparison of groups	667/976 (68%) DHCWs vaccinated with all 3 injections. -- 93% of students, 51% of faculty, 29% of staff were vaccinated -- 55% (271/495) of vaccinated students responded, 65% (72/101) of vaccinated faculty responded, 79% (46/58) of vaccinated staff responded 312 (32%) DHCWs non-vaccinated -- 7% of students, 49.5% of faculty, 71.3% of staff were not vaccinated -- 45% (57/60) of non-vaccinated students responded, 35% (61/108) of non-vaccinated faculty responded, 21% (79/144) of non-vaccinated staff responded. Of the DHCWs who were not vaccinated and responded to the survey, 53/197 (26.6%) claimed to have anti-bodies to hep B. That is 19/57 (37%) of students, 25/36 (41%) of faculty and 9/79 (12%) of staff.
Drop outs, crossovers and adherence	390/976 (40%) non-response to mailed survey and one mailed reminder - 40.1% of students, 39.3% of faculty, 38.1% of staff did not respond - 41.4% of vaccinated and 36.9% of non-vaccinated did not respond

	According to study, response rates (adherence) for individual questions were even less due to incomplete studies.
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → Study (n/a) Study → groups (+) Selection bias is not applicable from source to study b/c all subjects were included. Volunteerism affecting drop-out rate seems to be consistent across all respondents. Study groups were based on institution records of vaccination status, which are likely accurate and unbiased.
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: same survey to all participants Reliable: Pretesting on 30 individuals. A chronbach's alpha value of 0.6482 was obtained with an SPSSX reliability program, used to assess the consistency of responses on the survey instrument concerning the susceptibility component of the health belief model. Validity: self-reported outcomes w/o follow-up
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: All faculty (clinical and research), students (dental, dental hygiene and graduate), and staff (auxillaries, administrators, secretaries and support personnel), at the University of Michigan School of dentistry between Sept 1984 to February 1985. Controling: age, sex, occupation , knowledge about antibody status and percent of time spent in direct patient contact. Others: - Vaccine cost was reduced but different among the groups ($105 for faculty and staff) and $25 for students - did not properly account for persons who had previous vaccination or who have unknown status - arbitrary definition of "at risk" set at >2% of time in patient contact (in reality, any contact puts them at risk). Motivators: (+) vaccine education program (+) motivational appointment scheduled (+) vaccination administration located within the school of dentistry (+) awareness campaign via PA systems and schools newsletter
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	- Primarly analysis of exposure/intervention by vaccine acceptance was performed by Chi-squared. - However, "when expected chi-square frequencies were found to be less than five, categories were collapsed appropriately to increase the number of respondents in a particular group", resulting in comparison of combined endpoints. - The group determined to be "no antibodies" actually included those who responded to the questionnaire as not having antibodies to hep B and those who did not know their immunologic status. - Primary analysis stratified responses in to groups by age, sex, occupation, percent of patient contact, and participation/nonparticipation in the

	vaccinations program. - Secondary multi-variate analysis was conducted with stepwise logistic regression, for the variables of age, sex, occupation, knowledge about their antibody status and percent of time spent in direct patient contact. - Likert-type scales then assessed the following perceptions: susceptibility to hepatitis, susceptibility to possible side effects of vaccination such as guillian-barre syndrome or AIDS, the severity of contracting hepatitis, barriers to vaccination such as cost and accessibility, the effectiveness of the vaccine, and the effectiveness of structured motivational cue.
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	- Overall, 667 students, faculty and staff received all three injections. - Overall, 68.5% (667/979 ??) overall acceptance rate of vaccine - group rates for vaccine acceptance: students 93% (495/555??), faculty 50.5% (111/219??), and staff 28.7% (58/202) - students and faculty had significantly higher vaccination rates than staff - Overall, 618/979 persons returned questionnaires (63.1% response rate) - Similar response rate among each group of participants: students 59.1% (328/555), faculty 60.7% (133/219) and staff 61.9% (125/202) - Of the non-vaccinated, 67% of students (38/57), 59% of the faculty (36/61), and 88% of the staff (56/79) did not have antibodies or did not know their immunologic status. - The "at risk" population defined as those who spent more than 2 percent of their time in direct patient contact and accounts for 95.2% (n=471) of the respondents. - Of those at-risk overall, belief that severity of hepatitis B is great (96%), effectiveness of vaccine is high (88%), and susceptibility to hepatitis is high (66%) - Of those at-risk overall, barriers to vaccination: cost (25%), time (5%) - Of those at-risk overall, incentives to vaccination: 90% believe that organization and access facilitate participation, 87% believe that a motivational cue triggered vaccination - Of those at-risk overall, fear of side effects from hepatitis B vaccination was relatively low, but not zero. belief that susceptibility to side-effects are high for GBS (4%), AIDS (4%), affects on pregnancy (46%), unknown (7%) - Of those at-risk, vaccinated participants were more likely to feel that they were susceptible to hepatitis B, that contracting hepatitis B would have a significant effect on their lives, that the scheduled vaccination appointments were a cue or a trigger to action than non-vaccinated and that the vaccine was effective in the prevention of hepatitis B. - Of those at-risk, non-vaccinated were more likely to identify cost as a barrier to vaccination, to feel that the vaccination process (three-injection format over a six-month period of time) was time consuming, to be unsure about the accessibility of the vaccination site, and to feel that all the side effects of the vaccine were not known. - Of those at-risk, susceptibility to hepatitis B, the cost of the vaccine, the access to the vaccine, the highly structured vaccine program, the respondent's age, the motivational cue, the respondent's occupation, and beliefs about the severity of hepatitis B had significant effects upon acceptance of the vaccine.

	When respondents grouped by age (<26, 26-45, >45): - those older than 45 years were less likely to feel that susceptible to hepatitis is high or severity of hepatitis is great. - those <26 and those >45 were more likely to perceive that the cost of vaccination is too high - those >45 were more likely to believe that vaccination is too time consuming.
Internal validity	Poor: study has major flaws with conclusions that should be considered invalid - poor analysis and conclusions: ▪ Analyzed data with exposure (dependent variable or X) was acceptance/nonacceptance of Hepatitis B (see results on pg 70). Yet, the analysis routinely refers to various factors (dependent variable) which are determinants of Hepatitis acceptance/nonaccpetance (outcome, independent variable or Y). ▪ Incorrectly calculated data: vaccine acceptance rate of students is listed in the table as 495 out of 555 = 89.2%. yet is quoted in the results as 93% acceptance. Also, the table lists 664 subjects out of 976 total accepted the vaccination (vaccination rate = 68.0%). Yet, the text under methods states that 667 persons out of 979 total accepted the vaccination (vaccination rate = 68.1%). Both of these numbers are than the difference of 68.5% stated in the results section on page 68. If these simple calculations cannot be performed correctly, I am suspicious that none of the calculations are performed correctly. ▪ Retrospectively adjusted data for analysis: "when expected chi-square frequencies were found to be less than five, categories were collapsed appropriately to increase the number of respondents in a particular group" (methods pg 68). ▪ Considered those who may have had previous vaccination or whose vaccination status is unknown as nonacceptance for purposes of analysis. This would mean there is the potential for vaccinated individuals to be in the "nonaccpetance" grouping. ▪ "at risk" was analyzed as a dichotomous variable, with >2% means yes and <2% means no, even though the table clears shows that there is more than 2 categories. - Faculty and staff paid $105 for vaccine, students paid $25 - arbitrary definition of "at risk" set at >2% of time in patient contact. - would probably be more appropriate to evaluate patient contact time as a continuous variable, or at least have categories with equal distribution of time in patient contact (eg <25%, 25-50%, 51-75%, >75%).
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of the University of Michigan Dental School is a non-randomized convenience sample of all Health Care Workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Qureshi M, Gordon SM, Yen-Lieberman B, Litaker DG.Controlling varicella in the healthcare setting: barriers to varicella vaccination among healthcare workers.Infect Control Hosp Epidemiol. 1999 Jul;20(7):516-8.
Question asked	What factors may influence acceptance of varicella-zoster virus vaccine?
Intended population	Health care workers in the U.S.
Research design	Cross-sectional survey. Method: telephone survey (non-anonymous)
Source Population (inclusion and exclusion)	Inclusion: Healthcare workers, undergoing pre-employment evaluation at the Cleveland clinic foundation, Between June 1996 and August 1997, who did not have proof of immunity at pre-employment evaluation, and lacking antibodies to VZV by serum screening Exclusion: not included above
Source Demographics	- 2,801 HCWs underwent testing for VZV serology at the time of employment: - 90 (3%) were susceptible to VZV - Unknown: age, sex, race, SES, occupation
Study Population (inclusion and exclusion)	Inclusion: All Exclusion: none
Study Demographics	90 total persons Among those that responded 70/90 (78%) Mean age 27 76% female 56% Caucasian 21% nurses, 13% nurse assistant, 10% physician 27% reported history of chickenpox - Unknown: SES
Method to create study groups	Self-reported: receipt of VZV vaccine
Comparison of groups	No further data given
Drop outs, crossovers and adherence	20/90 (22.2%) non-response - unable to be contacted, interviewed, and included in the study after 3 attempts to contact between October and November 1997 Of the 20 drop-outs, 3 refused to be interviewed, and 17 could not be contacted by telephone.
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → study (n/a) Study → groups (++) Selection bias is not applicable from source to study b/c all subjects were included. No data described differences between respondents and non-respondents. Therefore, effects of volunteerism cannot be assessed. Study groups were created by self-reported status. Therefore, selection bias may have occurred.
Equal, reliable, valid measurements	Equal: same survey to all participants Reliable:

(intervention/exposure, outcome)	Validity: self-reported outcomes w/o follow-up - non-anonymous survey may produce measurement bias
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restriction: Healthcare workers, undergoing pre-empolyment evaluation at the Cleveland clinic foundation, Between June 1996 and August 1997, who did not have proof of immunity at pre-employment evaluation, and lacking antibodies to VZV by serum screening Others: Motivators: - Free vaccines - Notified of antibody status by mail
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	- Data analysis was done using SPSS software (version 7.5, SPSS Inc, Chicago, IL). Analysis was by chi-square and nonparametric methods, where appropriate. A $P<.05$ was considered statistically significant. - HCWs were queried as to whether they were offered or if they received varicella vaccine and also were asked the primary reason for accepting or not accepting the VZV vaccine.
Results: magnitude and direction (point estimate; random error or precision (confidence interval); statistical significance	- Overall, 2,801 HCWs underwent testing for VZV serology at the time of employment - Overall, 90/2801 (3%) were susceptible to VZV, of whom 70/90 (78%) were contacted, interviewed, and included in the study - Of the 20 drop-outs, 3 refused to be interviewed and 17 could not be contacted - Of the susceptible respondents: 53 (76%) recalled receiving written notification of their VZV serological status and an offer of VZV vaccination - of those that received an offer for vaccinination (53), 72% (38) accepted and 28% (15) refused. - Beliefs of those that received the vaccine represents only 38 people - Among those that received the vaccine % believed in the following reasons (74% desired immunity, 24% wanted to avoid infection in others, 21% followed hospital recommendation) - Beliefs of those that didn't receive the vaccine represents only 15 people - Among those that did not receive the vaccine % believed in the following reasons (33% believed it not necessary, 26% feared side effects, 20% pregnant, 20% inconvenienced) - There were no statistically significant differences in knowledge and attitudes regarding VZV and vaccine between those who did and did not receive

	the vaccine." - "However, of the 53 HCWs offered vaccination, 27 (71%) with direct patient care received vaccination compared to 6 (40%) of HCWs without direct patient-care responsibilities (odds ratio, 3.7; 95% confidence interval, 0.9-16; $P<.05$)." - "Six (53%) of the susceptible HCWs who initially declined the vaccine indicated that they would receive VZV vaccination at the time of the telephone questionnaire." - "Vaccine-associated varicella developed in 3 (8%) of the HCWs who received the vaccine; all occurred within 60 days after the first dose, were localized, were not associated with varicella exposures, and did not result in secondary cases."
Internal validity	Fair: study does not have any major flaws with conclusions that should be interpreted with caution - Retrospective exclusion of 24% of participants from the study because they did not recall receiving notice of their immunization status and offer for free vaccination in the mail - numbers of people who expressed opinions about receiving the vaccine (38) or did not receive the vaccine (15) are very small subgroups.
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, the source population of the Cleveland Clinic Foundation is a convenience sample of all health care workers in the U.S.

Name:	Critical Appraisal
Citation (JAMA style)	Jordan J, Weber D.
Question asked	What are the perceptions of the new Tdap immunization recommendation among health care workers?
Intended population	Health Care workers
Research design	Cross-sectional survey. Method: anonymous paper based
Source Population (inclusion and exclusion)	Inclusion: Health care workers undergoing new employee orientation for UNC Health Care Systems, during the month of March, 2007. Exclusion: not included above, non-english speaking
Source Demographics	133 total
Study Population (inclusion and exclusion)	Inclusion: all Exclusion: none
Study Demographics	76 respondents See masters paper for further analysis of participants
Method to create study groups	No groups
Comparison of groups	N/A
Drop outs, crossovers and adherence	57 (43%) non-response to survey 3% of questions not answered among returned surveys
Potential for selection bias (+ to +++) Source → Study Study → Groups	Source → Study (n/a) Study → Group (n/a) All eligible source population were included No groups to select into. Volunteer bias may have unknown effect on results
Equal, reliable, valid measurements (intervention/exposure, outcome)	Equal: same survey for all participants Reliable: pre-tested survey Validity: self-reported outcomes w/o follow-up - anonymous survey
Potential for measurement bias (+ to +++) Blinding?	(++): Moderate measurement bias due to nature of surveys - No blinding
Potential confounders (randomization, restriction, matching, controling)	Restricting: population was restricted to English speaking individuals
Potential for confounding (+ to +++)	(++): Moderate potential for confounding due to nature of surveys
Analysis (intention to treat or other adjustment)	Data were analyzed with Stata 9
Results: magnitude and	See Master's paper

direction (point estimate; random error or precision (confidence interval); statistical significance	
Internal validity	Good: well designed study with conclusions that can be applied to intended population
External validity	Poor: Surveys and questionnaires are difficult to project onto other populations due to the inherit subjectivity of the content. In addition, The source population of health care workers at UNC new employment orientation is a convenience sample of all Health Care Workers in the U.S.