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Short communication

Have you had a tetanus booster in the last 10 years? Sensitivity and specificity of the question☆

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Abstract

Objective: To evaluate the accuracy of patients' recall of their last Tetanus/Diphtheria (Td) booster in the setting of employee health clinics known for high immunization rates and good documentation of vaccine status.

Methods: Five hundred and seventy-two patients of an employee health clinic answered a written questionnaire about whether they have had a Td booster in the last 10 years. Answers were compared with patients' charts as the gold standard.

Results: The sensitivity of the question is 92.4% (95% CI 89.0–95.0) and specificity is 26.5% (95% CI 12.9–44.4). Positive predictive value is 92.6% (95% CI 89.3–95.2) and negative predictive value is 25.7% (95% CI 12.5–43.3). Age and gender do not affect the accuracy of recall.

Conclusion: A positive answer to this question is highly reliable whereas a negative answer is unreliable.

Practice implications: In the setting of employee health clinics, when patients affirm the receipt of a Td booster within the previous 10 years, it is quite likely that they are up to date and do not require re-administration of the vaccine. Any other answer to this question (No, I do not know) is unreliable and a booster should be recommended if not contraindicated.

Keywords: Tetanus vaccine; Patient recall; Immunization; Sensitivity; Specificity

1. Introduction

In the absence of accessible national vaccination registry, querying patients about their immunization status continues to be the only practical way to obtain immunization history and determine the need for further administration of vaccines. However, accuracy of patient provided immunization history is subject to recall bias and was often found to be either poor or inconsistent among the different vaccines. Patients either forget receiving vaccines or mistake them for other injections such as tuberculosis skin test or injectable analgesics [1].

Patient recall of certain vaccines, such as rubella, varicella, pneumococcal and influenza, appears to be somewhat reliable (Table 1) [2–9]. On the other hand, Tetanus–diphtheria (Td) vaccination boosters, which are indicated every 10 years for adults, are particularly difficult to remember [1,10]. The length of time between vaccine boosters is a possible obvious contributing factor. The accuracy of adult patients remembering whether they had a Td booster within a certain period of time was evaluated in two studies: in urgent care setting, only 44% of Td vaccinations claimed by patients were verified in medical records [1]; and in family medicine clinics, only 57% of patients were able to correctly recall their tetanus vaccination [10]. No study evaluated the accuracy of patients' recall of Td vaccines in the setting of employee health clinics, a setting with ready access to healthcare, higher immunization rates, and better documentation of vaccine administration.

The objective of this study is to evaluate the accuracy of patients' recall of such a rare event during visits to employee health clinics, which is always considered an opportunity to update employees' immunization records and administer indicated vaccines. In addition, since patients' age and gender can affect their recall of health related events [11,12], we evaluated these variables in terms of their effect on the accuracy of patient reported vaccination status.

☆ Related presentations: The International Conference on Communication in Healthcare, October 2007, Charleston, SC; The Tenth Annual Conference on Vaccine Research, May 2007, Baltimore, MD.

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Table 1
Patients recall of immunizations other than tetanus

Study	Methods and settings	Vaccine	Result
Bedford et al., [4]	Mailed questionnaire, patients aged 65 years and older	Influenza	Agreement between patient reporting and medical chart (Kappa statistic) of 0.9
Burnham et al., [2]	Health questionnaire of freshman cadets in the U.S. Air Force Academy	Rubella Varicella	Positive predictive value 99% Positive predictive value 86%
Hutchison et al., [8]	Mailed questionnaire to seniors enrolled in a group family practice	Influenza	Sensitivity of 93%; specificity of 98%
Mac Donald et al., [7]	Mailed and telephone surveys of patients of the Veteran Affairs and community managed care organizations	Influenza	Sensitivity of 98% to 100%; specificity of 71% to 79%
		Pneumococcal	Sensitivity of 90 to 97%; specificity of 53% to 64%
Martin et al., [5]	Telephone survey of health maintenance organization subscribers	Influenza	Sensitivity 86% to 99%
Nichol et al., [9]	Mailed questionnaire to randomly selected patients	Influenza	Kappa statistic: 0.6 to 0.8 higher kappa for high risk patients (0.8–0.9)
Shenson et al., [3]	Population based survey, patients are 65-year or older	Pneumococcal	Sensitivity of 75%; specificity of 83%
Zimmerman et al., [6]	Computer assisted telephone interviewing, patients aged 66 and older in urban and inner cites	Influenza Pneumococcal	Sensitivity of 98%; specificity of 38% Sensitivity of 85%; specificity of 46%

2. Methods

This is a retrospective analysis of a convenience sample of 572 consecutive adult patients that presented to the employee health clinic at the Mayo Clinic in Rochester, MN. Upon hire, an occupational nurse evaluates and updates the immunizations of prospective employees. Triggers for Td vaccination thereafter are determined by their primary care providers. No special reminders about Td vaccine are sent to employees.

Patients are asked to fill a standard form called (Current Visit Information) that contains the question: ''have you had a Tetanus/Diphtheria immunization within the last 10 years?'' Answers are compared with documented immunizations in patients' electronic medical records. Patients' answers are treated as a test variable and the medical record is treated as the gold standard. Sensitivity is calculated to represent the probability of a patient answering ''yes'' on their questionnaire among those with a confirmed Td vaccination history within the last 10 years in the medical record. Specificity is calculated to represent the probability of a patient answering ''no'' on their questionnaire among those with a tetanus vaccination that lapsed more than 10 years in the medical record. Positive predictive value is calculated to represent the probability of a confirmed Td vaccination history within the last 10 years in the medical record among those who answered ''yes'' and negative predictive value is calculated to represent the probability of a tetanus vaccination that lapsed more than 10 years in the medical chart among patients answering ''no''. Data are analyzed by SAS software (SAS institute Inc., Gary, NC). The exact binomial 95% confidence intervals of these probabilities are estimated and the Kappa statistic is used to measure the agreement between patients' answers and the medical chart [13]. Fisher's Exact Test is used to compare answers between subgroups based on age (under than 50 years old vs. 50 or older) and gender.

3. Results

Data were collected from 572 patients. The mean age of patients is 50 years. Overall immunization rate is 87.6%. About two thirds of the patients (375, 65.6%) answered ''yes'' or ''no'' and their answers are used to calculate probabilities and agreement. Sensitivity, specificity, positive predictive, negative predictive value and agreement are presented in Table 2. We found no statistically significant effect of age or gender on the accuracy of recall (Table 3).

A total of 197 patients (34.4%) either did not answer the question (72 patients, 12.6%), answered ''unknown'' (90 patients, 15.7%), or their immunization history was not available in the medical records (35 patients, 6.1%). Of the patients who did not answer the question or answered, ''I do not know'', 76.5% were actually up-to-date and have had a Td booster within the previous 10 years. Assuming these patients answered ''no'' to the question decreases sensitivity to 69.2% (95% CI 64.7–73.4) and increases the specificity to 65.7% (95% CI 53.7–76.4). Assuming they answered ''yes'' slightly

Table 2
Overall accuracy of recall

	All patients $N = 375$	
	Received Td per chart	Did not receive Td per chart
Answered ''Yes''	315	25
Answered ''No''	26	9
Sensitivity (95% CI)		92.4 (89.0–94.9)
Specificity (95% CI)		26.5 (12.9–44.4)
Positive predictive value (95% CI)		92.6 (89.3–95.2)
Negative predictive value (95% CI)		25.7 (12.5–43.3)
Agreement (Kappa) (95% CI)		0.2 (0.0–0.3)

Td: Tetanus/Diphtheria booster.

Table 3
Recall accuracy by gender and age

	Males $n = 145$	Females $n = 230$	Gender effect (p-value)	Patients 50 or under $n = 189$	Patients over 50 $n = 186$	Age effect (p-value)
Sensitivity (95% CI)	89.3 (82.7–94.0)	94.3 (90.3–97.0)	0.74	93.6 (88.8–96.8)	91.2 (85.9–95.0)	0.87
Specificity (95% CI)	42.9 (17.7–71.1)	15.0 (3.2–37.9)	0.26	38.9 (17.2–64.3)	12.5 (1.6–38.4)	0.26
Positive predictive value (95% CI)	93.6 (87.8–97.2)	92.1 (87.6–95.3)	0.93	93.6 (88.8–96.8)	91.7 (86.5–95.4)	0.94
Negative predictive value (95% CI)	30.0 (11.9–54.3)	20.0 (4.3–48.1)	0.72	38.9 (17.3–64.3)	11.8 (1.5–36.4)	0.26
Agreement (Kappa, 95% CI)	0.3 (0.0–0.5)	0.1 (0.0–0.3)	N/A	0.3 (0.1–0.5)	0.0 (0.0–0.2)	N/A

increases sensitivity to 94.3% (95% CI 91.7–96.2) but decreases the specificity to 12.3% (95% CI 5.8–22.1).

4. Discussion and conclusion

4.1. Discussion

Our data show that in employee health clinics, asking patients whether they had a Td booster in the last 10 years is associated with high sensitivity (92.4%) and positive predictive value (92.6%). Conversely, the question is associated with low specificity (26.5%) and negative predictive value (25.7%). Age and gender do not significantly alter the accuracy of the answer. Patients who answer ''I do not know'' or do not answer the question have lower immunization rate than those who answer ''yes'' or ''no'' and sensitivity analysis shows that changing their answers significantly impacts the overall accuracy.

Two other studies evaluated accuracy of Td vaccine recall in adult patients. Gindi et al. described a survey administered by residents in an emergency department [1]. Fishbein et al. utilized a written survey adapted from a self-assessment tool from the Centers for Disease Control and Prevention (CDC) and administered in family practice clinic setting [10]. Our study demonstrates higher positive predictive value than both of these studies (92.4%, compared with 44% and 30%, respectively) and a negative predictive value (26.5%) that is similar to the one reported by Gindi et al. (26%) and lower than the one reported by Fishbein et al. (65%). Since, measurement instruments are fairly similar, the differences are likely due to the heterogeneity in study populations and practice settings.

The main limitation of this study is external validity. First, results may not apply to other settings with lower immunization rates or different population characteristics (e.g., accuracy may be lower in stressful situations such as an emergency room visit). Second, in studies that evaluate the accuracy of patients' recall of health services received, results are affected by the trust patients have in their environment of care (for example, patients who had a recent myocardial infarction may answer ''yes'' when asked if they had a recent serum lipid test because they trust their doctors to do all appropriate tests). Nevertheless, we think our results are applicable to settings such as employee health clinics, occupational health clinics, hospital staff and nurses, etc.; and are also likely applicable to the newer combination vaccine, Tetanus/Diphtheria/Pertussis or (Tdap), because it is administered at the same time interval and during similar clinical situations (e.g., pre-employment exams, annual exams).

Utilizing patient-provided vaccine status is certainly not the ideal solution and proper documentation of vaccination history should always be the sought. Nevertheless, in the absence of such documentation, physicians are limited to what patients report.

4.2. Conclusion

When patients of employee health clinics remember receiving a Td booster within the last 10 years, they are likely to be correct. Any other answer to the question (No, I do not know) is highly unreliable.

4.3. Practice Implications

Clinicians do not need to offer a Td booster to patients who remember receiving one within the last 10 years. Those who think their booster has lapsed or are unsure should be offered one during their current visit. Patients should be counseled that early administration of a booster may be associated with higher incidence of side effects [14,15]. When the prevention of pertussis is a major concern (health care workers, the postpartum period, persons in contact with infants), Tdap booster should be offered to all patients less than 65 years of age if 2 years have passed since their last Td booster [16,17].

Conflict of interest

None.

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