

# Assessing Penicillin Allergies with a Structured Assessment Form

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## ABSTRACT

**Objective:** Assessment for penicillin allergy is not always optimal, and sometimes alternative antibiotics are prescribed for patients who are not in fact allergic to penicillin. The purpose of this study was to compare the current unstructured method of assessing and documenting penicillin allergy at St. Joseph's Hospital, Hamilton, Ontario, with the use of a structured assessment form.

**Methods:** Adult patients with documented allergy to penicillin who were admitted to the Day Surgery Unit between January and May 1998 were interviewed with an assessment tool that classified their allergy as probably a true allergy, possibly a true allergy, a side effect or intolerance, or an unlikely allergy. A second instrument was used to review the allergy assessment recorded in the patient's chart. The primary outcome was the difference between the 2 methods in the prevalence of probable and possible true allergies. Secondary outcomes included the consistency of chart recording, documentation of details of the allergic reaction, antibiotics used, and referrals to an allergist.

**Results:** For the 60 patients interviewed, the allergy was classified as probably true in 18 (30%), possibly true in 32 (53%), a side effect or intolerance in 8 (13%), and unlikely in 2 (3%). The prevalence of a probable or possible allergy according to the structured assessment form (50/60 [83%]) was significantly different from the prevalence as determined by the current method (100%) ( $p = 0.0044$ ).

**Conclusions:** Use of the structured assessment form reduced documentation of penicillin allergies by 17%; use of this form would allow selected patients (those with probable or possible allergies) to be referred to an allergist before surgery.

**Key words:** penicillin, allergy, documentation, assessment

## RÉSUMÉ

**Objectif :** L'évaluation des allergies à la pénicilline n'est pas toujours précise et dans certains cas des antibiotiques sont prescrits pour les patients qui ne sont pas en fait allergiques à la pénicilline. Le but de cette étude était de comparer les méthodes actuelles non structurées d'évaluation et de documentation des allergies à la pénicilline au St. Joseph's Hospital, de Hamilton, en Ontario, avec une méthode structurée fondée sur un formulaire.

**Méthode :** Des patients adultes dont l'allergie à la pénicilline était documentée et qui ont été admis en chirurgie d'un jour entre janvier et mai 1998 ont été interviewés à l'aide d'un outil d'évaluation qui classifiait leur allergie comme étant probable, possible, un effet secondaire ou une intolérance, ou peu probable. Un autre outil a été utilisé pour analyser les résultats de l'évaluation de l'allergie qui ont été consignés dans le dossier du patient. La principale observation était la différence entre les deux méthodes au chapitre de la prévalence des allergies qualifiées de probables et de possibles. Les observations secondaires étaient la continuité de la documentation des informations au dossier, les détails de la réaction allergique, les antibiotiques prescrits et les demandes de consultation à un allergologue.

**Résultats :** Des 60 patients interviewés, l'allergie a été classifiée comme étant probable dans 18 (30 %) cas, possible dans 32 (53 %), un effet secondaire ou une intolérance dans 8 (13%), et peu probable dans 2 (3%). La prévalence des allergies probables ou possibles déterminée selon la méthode d'évaluation structurée (50/60 [83 %]) était notablement différente de celle déterminée selon la méthode d'évaluation non structurée actuelle (100 %) ( $p = 0.0044$ ).

**Conclusions :** Le recours au formulaire d'évaluation structurée a fait diminuer les rapports de cas d'allergies à la pénicilline de 17 %; ce formulaire permettrait à des patients choisis (ceux dont l'allergie est probable ou possible) d'être adressés à un allergologue avant d'aller en chirurgie.

**Mots clés :** pénicilline, allergie, rapport, évaluation

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## INTRODUCTION

The documentation of “penicillin allergy” in a patient’s chart is relatively common. However, the prevalence of true penicillin allergy in the general population is estimated at only 1% to 10%.<sup>1</sup> Because of the risk of life-threatening reactions, it is important to distinguish between patients who are truly allergic and those who have an intolerance or adverse reaction to these agents.

Immediate hypersensitivity reactions to penicillin are mediated by IgE antibodies and are classified as type I reactions according to the Gell and Coombs system.<sup>1-3</sup> Type I reactions usually manifest as anaphylaxis, laryngeal edema, or urticaria within 72 h of initiation of the penicillin therapy. Late reactions occur after 72 h and often present as morbilliform rash. These reactions are not IgE mediated, so do not result in anaphylaxis. Medical histories as reported by patients are often vague and unreliable, so it is difficult to distinguish between these types of reactions. The penicillin skin test is useful for identifying IgE-mediated reactions.<sup>2</sup>

If an allergy to penicillin is suspected, caution must be exercised in prescribing cephalosporins because of the potential cross-sensitivity between penicillin and  $\beta$ -lactam antibiotics. The true prevalence of cross-sensitivity has not been established. Some studies reported a 5% to 16% risk of cross-sensitivity between these agents,<sup>3,4</sup> but other data suggest that the risk is probably much lower (less than 1%).<sup>5,6</sup> There is also some indication that the similarity between the side chain of penicillin and cephalosporin is what determines cross-sensitivity between these agents.<sup>7</sup> The third-generation cephalosporins are sufficiently different that there is a lower risk of allergic reaction to cephalosporin in a patient who is allergic to penicillin, whereas the first-generation and second-generation cephalosporins may pose a slightly greater risk.<sup>6</sup>

St. Joseph’s Hospital, in Hamilton, Ontario, is a 500-bed acute care teaching hospital providing a variety of medical and surgical services. Pharmacy services are provided through a centralized pharmacy department. The hospital has access to an allergy clinic, and referrals to an allergist are available upon consultation. The hospital’s current system of assessing and documenting allergies involves questioning the patient on admission. Currently, the procedure for allergy assessment is not standardized, and allergies are recorded according to the patient’s recall. It is not a requirement to document the symptoms of the allergy, so such details are often not recorded. The allergy is documented on the front of the

patient’s chart, on the admission sheet, in the nursing notes, on the physician orders, and in the hospital computer. Medication orders cannot be entered into the hospital computer until the pharmacist has entered the allergy status of the patient.

It would be beneficial to improve the assessment and documentation of penicillin allergies to improve patient care. Currently, when an allergy to a penicillin is suspected, a therapeutically less effective or more toxic agent, such as vancomycin, ciprofloxacin, or erythromycin, is generally used. The use of these alternatives may change microbial resistance patterns; for example, the use of vancomycin contributes to the emergence of vancomycin-resistant enterococci.<sup>8</sup> Some of these alternative treatments are more expensive than the penicillin or cephalosporin that would be given to patients not allergic to penicillin. Furthermore, if a patient is listed as having a penicillin allergy and an intravenous cephalosporin is ordered, St. Joseph’s Hospital policy specifies that the physician must administer the first dose. This is time-consuming and often results in the physician ordering an alternative to cephalosporin. Developing a standard procedure for determining patients’ true allergy status will allow more appropriate antimicrobial therapy.

Types of allergies and the impact of proper allergy assessment and documentation have been studied in some hospital settings. One study, by Glover and Trotter,<sup>9</sup> evaluated the drugs implicated in allergic reactions over a 6-week period and classified these reactions by severity. They found that a third were “probably true” allergies, a third were “side effects” and the other third were “questionable”. Preston and colleagues<sup>10</sup> evaluated the documentation of penicillin allergy in 3 locations: the pharmacy profile (100% of cases), the medical chart (99%), and the medication administration record (97%). Of the 117 patients assessed, 83% were classified as having an allergy and 17% as having an intolerance. Tripp and Brown<sup>11</sup> examined the impact of allergy assessment conducted by pharmacists. As a result of these assessments, the allergy label was removed from the chart in 28% of cases. In a study by Pilzer and colleagues,<sup>12</sup> the accuracy of drug-allergy reporting in the records was compared with allergy assessment conducted by pharmacists. In 63% of cases an allergy could not be ruled out, in 25% of cases the allergy was classified as an intolerance, in 4% of cases the reactions were considered normal pharmacological effects of the medication, and in 8% of cases the patient did not have an allergy. These studies indicate that allergy reporting



is not always ideal. Structured allergy assessment can potentially improve this process.

The objective of this project was to compare the current unstructured method of recording penicillin allergy at St. Joseph's Hospital with use of a structured penicillin allergy assessment form. The results were used to formulate recommendations for the assessment and documentation of penicillin allergies at this institution.

## METHODS

This prospective trial was conducted from January to May 1998 at St. Joseph's Hospital. Approval for the study was obtained from the Committee for Ethics for Research. Written consent was obtained from each patient before participation in the study.

Patients in the Day Surgery Unit were considered eligible for enrollment if they were over 18 years of age and a penicillin allergy had been documented in the computer or on the front of their chart. Penicillin allergy was defined as reported allergy to ampicillin, amoxicillin, amoxicillin-clavulanic acid, bacampicillin, cloxacillin, flucloxacillin, penicillin G, penicillin V, piperacillin, pivampicillin, ticarcillin, and ticarcillin-clavulanic acid. Allergies to related compounds, such as cephalosporins, were not included.

The patients were prospectively assessed by 2 methods. They were initially interviewed by the pharmacy resident (L.D.H.) to obtain a history of the penicillin allergy. This information was used to classify the allergy, but no intervention resulted. After the interview, the chart was reviewed to assess the current method of assessing and documenting penicillin allergies. The information from the structured form was then compared with the information obtained through the existing process. For each method, an instrument, described below, was developed.

### Penicillin Allergy Assessment Form

The penicillin allergy assessment form was developed to ensure that patients were interviewed in a structured manner. This instrument (Appendix 1), based on previously established forms,<sup>13,14</sup> was created with the aid of an allergist. Face and content validity were taken into account. Several pharmacists and physicians, as well as an allergist, reviewed and commented on the tool, which was revised several times in response to these comments. The final form could be used to obtain a detailed history of the reaction directly from the patient. The allergy could then be classified into 1 of the 4 following categories:

- Probable true allergy: An allergic drug reaction is defined as a state of hypersensitivity induced by exposure to a drug and resulting in harmful immunologic reactions on subsequent exposure.<sup>15</sup> The reaction may present as urticaria, laryngeal edema, or anaphylactic shock.<sup>3</sup> Patients considered to have a probable true allergy should avoid the use of penicillin, unless they have been seen by an allergist and have been determined not to be allergic.
- Possible allergy: In this situation, a true allergy cannot be ruled out, because the patient cannot recall the reaction or the description of symptoms is vague. Patients considered to have a possible allergy should avoid the use of penicillin, unless they have been seen by an allergist and have been determined not to be allergic.
- Side effect or intolerance: A side effect or adverse drug reaction is an adverse consequence other than the one for which the drug is being used; drug intolerance is a reaction to the normal pharmacologic dose of a drug that has the symptoms of overdose.<sup>15</sup> In either situation, penicillin or a related compound could be used if indicated.
- Allergy unlikely: The patient states that he or she has no known allergy to penicillin, has used a penicillin since the original reaction without a problem, or has had a negative skin test or rechallenge to the medication. In these situations, penicillin or a related compound could be used if indicated.

Patients identified as having a probable or possible penicillin allergy should avoid the use of  $\beta$ -lactam antibiotics, unless they have been seen by an allergist. Patients with a probable or possible penicillin allergy and who would likely require a  $\beta$ -lactam antibiotic during the present admission or in the near future should be referred to an allergist.<sup>16</sup>

### Assessment of Chart Documentation

A form was developed to standardize the evaluation of the current method of assessing and documenting penicillin allergies (Appendix 2). The patients' medical records were evaluated after the interview (described above) was completed. The location of any documentation of a penicillin allergy, any details of the allergy, classification of the allergy, notes indicating referral to an allergist, antibiotics prescribed before and after surgery, the type of surgery, and the age and sex of the patient were recorded. A penicillin allergy recorded anywhere in the patient's chart was assumed to represent a probable or possible allergy.



## Analysis of Results

For the purpose of this study, the primary outcome was the prevalence of a probable or possible true allergy according to the 2 assessment methods. The required sample size was calculated on the basis of a minimally clinically significant difference of 15% in the prevalence of a probable or possible true allergy between the current method and the structured assessment.<sup>10-12</sup> It was assumed that all penicillin allergies were classified as true allergies according to the current unstructured method of assessment. Sixty subjects were needed to detect a true difference with a *p* value of 0.05 and a power of 0.80.<sup>17</sup> McNemar's  $\chi^2$  test was used to determine if the difference in the prevalence of probable and possible true allergies between the 2 methods was statistically significant.

Secondary outcomes were measured as well, including where the allergies were recorded in the medical chart, if any details of the allergy had been recorded, and the antibiotic used before and after surgery. The percentage of patients eligible for referral to an allergist according to the penicillin allergy assessment form was also examined. Recommendations for penicillin allergy assessment and documentation were formulated on the basis of the results of the study.

## RESULTS

From January to May 1998, a total of 60 penicillin-allergic patients from the Day Surgery Unit were enrolled in the study. It was assumed that if an allergy was recorded in the chart, it was considered a probable or possible true allergy according to the current method of assessment. The characteristics of the 60 patients are shown in Table 1. The mean age was 59 years, and there were slightly more women than men. The most common type of surgery was urological, followed by general surgery and head and neck surgery. Many patients reported allergies to a variety of other medications.

### Penicillin Allergy Assessment Form

All 60 patients described various reactions to penicillin. Skin reactions were most commonly reported, in 39 (65%) of cases. Descriptions included rash resembling chicken pox, itchiness, and hives. Swelling reactions were described by 10 (17%) patients, breathing problems by 4 (7%), and anaphylactic shock by 1 (2%). Of the 60 patients, only 3 (5%) had been seen by an allergist before the study, and all 3 had a positive skin-

**Table 1. Characteristics of 60 Patients with a Record of Penicillin Allergy Admitted for Day Surgery**

Characteristic	No. (and %) of Patients*
<b>Age, years</b>	
Mean $\pm$ SD	59 $\pm$ 17
Range	19 to 86
<b>Sex</b>	
Male	26 (43)
Female	34 (57)
<b>Type of surgery</b>	
Urological	25 (42)
General	12 (20)
Head and neck	9 (15)
Gynecologic	6 (10)
Cardiothoracic and vascular	4 (7)
Orthopedic	4 (7)
<b>Other allergiest</b>	
Sulfa	9 (15)
Narcotics	7 (12)
Erythromycin	4 (7)
ASA, NSAID	3 (5)
Other antibiotics	5 (8)
Other	5 (8)

ASA = acetylsalicylic acid, NSAID = nonsteroidal anti-inflammatory drug.

\* Except where otherwise indicated.

† Some patients had more than one allergy.

**Table 2. Classification of Allergy on Basis of Interview with Structured Allergy Assessment Form**

Classification of Allergy	No. (and %) of Patients
Probable true allergy	18 (30)
Possible true allergy	32 (53)
Side effect or intolerance	8 (13)
Allergy unlikely	2 (3)

test result. The reactions reported in 8 (13%) of the cases were actually side effects, the most common being gastrointestinal disturbance. Some patients reported having more than one type of reaction. It was interesting that 31 (52%) of all patients could not recall the details of the allergic reaction.

On the basis of the information gathered in the interview, the patient's allergy was classified into 1 of 4 categories (Table 2). Only 18 (30%) of the patients were considered to have a probably true immune-mediated reaction to penicillin, while 32 (53%) were considered to have a possibly true allergy. Patients who had side effects or intolerance accounted for 8 (13%) of all cases, and 2 (3%) had used a penicillin since the reported reaction and a true allergy was thus considered unlikely. If it is assumed that the current unstructured method



of chart documentation identifies only patients with a probable or possible true allergy, then the assessment tool identified significantly fewer such patients (60 identified by current method, 50 identified by structured method;  $p = 0.0044$ ).

### Assessment of Chart Documentation

The recording of penicillin allergies in the medical chart (the current method of documentation) was inconsistent. The nursing notes in the medical chart, nursing allergies in the computer system, and the preassessment form each documented penicillin allergies for at least 58 (97%) of the 60 patients. However, the physician documented the allergy for only 53 (88%) of the patients (Table 3).

Details of the allergic reaction were incomplete in the medical chart. For the purpose of this study, symptoms were considered to have been documented if they were recorded in at least one place in the chart. Details were recorded somewhere in the chart for only 31 (52%) of the 60 patients. In 2 cases the documented symptoms differed from the details recorded during the interview.

### Use of Antibiotics

A variety of antibiotics were used for this group of patients. However, only 13 (22%) of all patients received antibiotics preoperatively or postoperatively, either alone or in combination. The following antibiotics were given preoperatively: vancomycin (7 patients), gentamicin (4 patients), cephalosporins (3 patients), metronidazole (3 patients), and ciprofloxacin (1 patient). The following antibiotics were given postoperatively: ciprofloxacin (4 patients), vancomycin (3 patients), cephalosporin (1 patient), clindamycin (1 patient), erythromycin (1 patient), gentamicin (1 patient), and metronidazole (1 patient). For cases in which cephalosporins were used, the classification on the basis of more detailed history-taking would have been side effect or intolerance or allergy unlikely. No adverse effects were noted as a result of the  $\beta$ -lactam therapy. On the basis of the interview results, 11 (18%) of the patients were considered appropriate for referral to an allergist, because their allergy was classified as probable or possible and they needed antibiotics for the current procedure.

## DISCUSSION

A penicillin allergy is often documented in a patient's chart without details of the reaction, in part

**Table 3. Location of Documentation of Penicillin Allergy in Patient's Chart**

Location	No. (and %) of Patients
Nursing notes in medical chart	60 (100)
Nursing allergies in computer	59 (98)
Patient preassessment form	58 (97)
Physician orders in medical chart	53 (88)

because the patient's description of the reaction may be vague. Because of the serious consequences of administering penicillin to a patient with a true immune-mediated reaction, alternative antibiotics are frequently ordered for patients with a reported penicillin allergy. Cephalosporins are usually avoided as well, because of the potential risk of cross-sensitivity between these agents.<sup>3,4</sup> Even though the risk is probably very low, the seriousness of the allergic reaction leads many physicians to avoid all  $\beta$ -lactam antibiotics. However, alternative antibiotics may be less efficacious and more expensive. In addition, this prescribing pattern may contribute to the development of resistant organisms.<sup>8</sup>

The results of this study show that allergy assessment is difficult. On the basis of the interview results, 53% (32/60) of the allergies were classified as "possible allergies". A small proportion of these patients probably have an immune-mediated reaction, but without a penicillin skin test, it is almost impossible to determine which patients are at risk. However, 16% (10/60) of the reported penicillin allergies were identified as intolerance or side effects or allergy unlikely; these cases are unlikely to represent true allergies. This reduced the number of patients needing alternative antibiotics and referral to an allergist.

In this patient population, 48% (29/60) of the charts did not record details of the reaction. This lack of detail can lead to several problems. Without a description of the reaction, it is impossible to assess the allergy without speaking directly with the patient. However, even when details are documented, there is no single standard place for recording the details, and searching through the chart can be time-consuming. Symptom documentation was not explicit, often consisting of brief details, in one or two words, and was thus difficult to assess. The information collected with the structured assessment tool, such as when the reaction occurred, the onset of symptoms, the treatment required, and a description of the reaction, allows for an assessment of the severity of the allergy. In 2 cases, the details recorded in the chart differed from those ascertained with the assessment form.



No patients were referred to the allergist before surgery on the basis of information recorded on the structured assessment form. Most physicians do not routinely refer patients to an allergist. However, on the basis of the criteria outlined in the assessment tool, 18% (11/60) of the patients were identified as appropriate for referral. The low proportion of patients deemed appropriate for referral could relate to the criteria for referral. Only patients with a probable or possible true allergy and requiring a penicillin or related compound before or after surgery were identified as appropriate for referral. Only 22% (13/60) of the study patients received antibiotics, so referrals would, by necessity, be low. According to the criteria for referral, those with a side effect or unlikely allergy would not be referred, which would have decreased the potential number of patients eligible for referral by 17% (10/60). There is a definite expense to the allergist assessment, but this has to be weighed against the possibility of reducing the cost of antibiotics and potentially reducing the development of resistance.

Allergies are typically documented in a number of places in the chart. The nursing notes and the record completed by the patient noted a penicillin allergy in at least 97% (58/60) of cases, while the physician documented penicillin allergies on the orders in 88% (53/60) of cases. It was interesting that for a few patients with side effects (not allergy), details of the reaction were recorded by the physician and alternative antibiotics were ordered.

This study was useful for assessing the current method of penicillin allergy assessment and documentation for comparison with a structured assessment tool. However, there are several areas in which it might have been improved. Only penicillin allergies were assessed here, but it would be useful to examine assessment and documentation for all allergies. A similar form that could be used to assess and record all types of allergies would be ideal. However, not all allergies have the same types of reactions, so a more general form would be needed, which would limit the accuracy and detail for a penicillin allergy. Testing for allergy to penicillin is readily available, which makes it relatively easy to determine the status of the allergy.<sup>2,18</sup> For many other drugs, allergy skin testing is not available, which makes confirmation much more difficult.

This study looked only at a select population of patients, those admitted to the Day Surgery Unit. Some of these patients receive antibiotics before and after their surgery. In addition, these patients are seen a few days to a week before their surgery in the Pre-Admission

Assessment Unit, so there is an opportunity to use the allergy assessment tool and involve an allergist without delaying treatment. Expanding the use of this tool to other areas of the hospital would be beneficial, especially if the structured assessment was done at the time of admission.

One person conducted all of the assessments in this study. Testing the reliability and validity of the assessment tool was not a component of the study, and it would be beneficial to determine if the results are reproducible with different interviewers. The same person performed the chart review, so there may have been bias in gathering the data. Only face and content validity of the form were determined in this study, so comparison of the results obtained by means of the structured assessment form with the results of penicillin skin testing would also help in determining the validity of the form.

The form was useful for collecting information about patients' allergy history. As a result, patients who would benefit from referral to an allergist could be readily identified. It would be beneficial to determine the impact of the form on the outcomes evaluated. The impact of referral to an allergist on antibiotic use and cost would also be a useful outcome.

Several recommendations for the assessment and documentation of penicillin allergies at St. Joseph's Hospital were formulated. It is recommended that one specific area in the chart be used to document appropriately assessed allergies. The assessment can be accomplished by means of the structured tool. If the assessment form is used in the Pre-Admission Assessment Unit, select patients can be referred to the allergist before their surgery. If a patient is determined not to be allergic, allergy documentation should be removed from their records. This or a similar form could eventually be used in all areas of the hospital for standard assessment of penicillin allergies. With access to an allergist and the aid of the assessment tool, the documentation of penicillin allergies could be more complete than is currently the case. It is anticipated that this will improve the overall quality of care for patients at St. Joseph's Hospital.

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## Appendix 1. Penicillin Allergy Assessment Form

Patient name: \_\_\_\_\_

1) Have you ever experienced an allergic reaction after taking penicillin?  yes  no

Agent: \_\_\_\_\_

Reaction	Y	N	How long ago?	How long on medication (that prescription) before reaction started?	Regardless of treatment, how long until perfectly normal?	These are some of the possible descriptions of reactions. (Please describe in next box) Some examples:	Describe the reaction	Any treatment required?
A) Skin reactions						Peeling Itchy Red all over Chicken-pox like Measles-like Hives: raised spots of various sizes (e.g., pea to saucer) that come and go day by day, hour by hour		
B) Swelling						For example, eyes, lips, throat, scrotum, long was each area swollen?)		
C) Breathing problems (in chest)						For example, shortness of breath, cough, tightness, wheeze		
D) Anaphylactic shock						For example, collapse, closing of throat, admitted to hospital (ICU)		
E) Positive skin test or rechallenge to penicillin						By whom and where	Dr: _____ Place: _____	
F) Other: _____								

2)  **Probable True Allergy:** Description of reaction sounds like a true allergic reaction.

3)  **Possible Allergy:** A true allergy cannot be ruled out, since the patient cannot recall the reaction or the descriptions of symptoms are vague.

If probable or possible allergy and patient likely requires penicillin during this admission or in the near future, refer to allergist

4)  **Allergy Unlikely**

No known allergy to penicillin

Used penicillin again since above reaction (without a reaction)

Negative skin test or rechallenge to penicillin (Where: \_\_\_\_\_ When: \_\_\_\_\_ Dr: \_\_\_\_\_)

5)  Used a cephalosporin since above reaction (without a reaction)

When: \_\_\_\_\_ What agent: \_\_\_\_\_ Where: \_\_\_\_\_

6)  **Side Effect / Intolerance**

Have you ever had a reaction to penicillin that makes you not want to receive that medication again?

Agent: \_\_\_\_\_

Reaction

A) GI: stomach upset, vomiting, constipation, diarrhea

B) CNS: drowsiness, dizziness, insomnia, hallucination, confusion, anxiety, seizures

C) High fever

D) Other (specify): \_\_\_\_\_

Yes

No

7) Other Information

Unable to obtain penicillin allergy information

Other allergies: \_\_\_\_\_

Pharmacist: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Comments: \_\_\_\_\_

ICU = intensive care unit, GI = gastrointestinal, CNS = central nervous system





