ABSTRACT

The present study set out to determine the validity of the information and the feasibility of using health diaries to monitor vaccine adverse events.

Mothers of children about to receive DPT vaccine were asked to keep a diary of their child’s health and their doctors were randomized into one of three groups: 1) a close follow-up (CFG); 2) a telephone follow-up (TFG); or 3) a mail follow-up group (MFG).

Diary return rates were good at 98.8%, 82.5%, and 86.2% for the CFG, TFG, and MFG groups respectively. Agreement between the parent and nurse on the existence of common symptoms was high, varying from 89.9% to 98.7%; redness and swelling was high at 78.5% and 96.2% respectively; and axillary temperatures was lower from 71.6% up.

This study found that health diaries were a valid and complete method for monitoring the most common types of vaccine-related illness, with the possible exception of body temperature.

ABRÉGÉ

L’étude visait à déterminer la validité de l’information des carnets de santé et la valeur pratique de leur utilisation pour suivre les effets indésirables des vaccins.

Nous avons demandé aux mères d’enfants prêts à recevoir le vaccin DCT de tenir un carnet de santé pour leurs enfants. Les mères et leurs médecins ont été regroupés de façon aléatoire en trois groupes : 1) un groupe suivi en personne (GSP), 2) un groupe suivi par téléphone (GST) et 3) un groupe suivi par correspondance (GSC).

Le taux de retour des carnets a été bon : 98,8 %, 82,5 % et 86,2 % respectivement pour le GSP, le GST et le GSC. Mères et infirmières se sont entendues dans une proportion élevée quant à la présence des symptômes communs (de 89,9 % à 98,7 %), de rougeurs (78,5 %) et d’enflures (96,2 %), mais dans une moindre proportion (71,6 % et plus) en ce qui avait trait à la température axillaire.

L’étude démontre que les carnets de santé sont une méthode valide et complète pour suivre les types les plus communs de réactions aux vaccins, à l’exception, peut-être, de la température corporelle.

Health Diaries for Monitoring Events Following Immunization

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The establishment of a national system to monitor adverse events following medical interventions is one of ten recommendations highlighted in a Consensus Workshop report (1989). Of major interest are adverse events following vaccination because new vaccines and formulations are being marketed in Canada every year. Since many of the adverse effects of vaccines are not fully appreciated until the vaccines have been in general use, post-marketing surveillance is crucial. Such surveillance has relied largely on voluntary reporting by physicians of presumed vaccine- or drug-related effects, but recent studies used nurse researchers, either over the telephone or through direct contact or a health diary.

Prior to the establishment of a national surveillance system, it is first necessary to demonstrate a reliable, valid, and feasible tool for gathering data from adverse health events following vaccination. We propose a health diary method on which early work has focused on the incidence of common symptoms and how people responded to them, such as chronic pain, psychiatric illness, childhood migraine, gastrointestinal symptoms, premenstrual symptoms, and self-care. As well, past health diary studies have dealt with methodological issues, such as: the effect on response rates of cultural and language differences; diary format; methods of improving compliance; and validity. The present health diary study had two objectives:

1. To test the validity of data collected by parents of vaccinated children using a health diary by testing the hypothesis that data (temperature, local reactions, systemic symptoms) recorded in the health diary at certain times after vaccination (i.e., 8 hours, 48 hours, 7 days, 21 days) would agree with data recorded by the nurse-observer at the same times using an identical form.

2. To assess the feasibility of a health diary method in providing complete data from a high proportion of mothers by testing the following two hypotheses: a) that parents receiving close follow-up by a nurse observer would have significantly higher response rates and more complete data than parents in two other groups (telephone follow-up group and mail follow-up group); and, b) that parents receiving telephone follow-up versus mail follow-up would demonstrate no significant difference in terms of return rates and completeness of the diary.

METHODS

Study design

This study was a cluster randomized controlled trial allocating family physicians to three follow-up programs for parents receiving a health diary after their children’s vaccinations (DPT): 1) close follow-up; 2) telephone follow-up, and, 3) mail only follow-up. The parent of a child receiving immunization was asked to complete the daily diary (available on request from the authors) for 21 days post-vaccination. In addition to a health diary, parents were
provided with a digital thermometer (Toshiba model 016-600) and a transparent reaction ruler with which to measure the size of any local redness or swelling.

The close follow-up by the nurse-observer in the CFG group permitted the assessment of validity, i.e., the comparison of the parent’s recording in the health diary with the nurses’ observations.

Randomization
Practices rather than parents were randomized in order to locate the research nurse within the geographic area of one practice at a time, to enable contact in the waiting room and arrangement of the key four follow-up visits in the home. To guard against systematic differences in the practice populations, practices were allocated to the three arms after stratifying for size of community and the doctor’s number of years of experience.

Study sample
The study included all parents presenting to the sentinel family physicians for a vaccination with DPT of a child between 2 months and 5 years of age.

The sample size of 80 per group had adequate power (0.80) to detect correlations at or above 0.35 between the parent and the nurse and to detect a 20% difference among groups in the proportion of parents completing the diary after accounting for the effect of cluster randomization.

Intervention
The three different follow-up strategies were:
1. The close follow-up group (CFG): Parents were contacted by the research nurse four times (at 8 hours, 48 hours, 7 days, 21 days) after the vaccination for two purposes: to have the nurse observe and record the status of the child and to encourage the parent to keep the diary.
2. The telephone follow-up group (TFG): Parents received telephone reinforcement of diary keeping and an opportunity to ask questions at 7 days and 22 days.
3. The mail follow-up group (MFG): Parents received two mail reminder letters, one at 7 and one at 22 days.

Outcome variable
The outcomes were the parent’s compliance with returning the diary (a dichotomous variable) and completeness of the diary as defined in three ways: 1) the number of days in which data were not provided by the parent (a continuous variable); 2) those diaries in which data were not provided for 20% or more days (4 days) and; 3) the number of missing items...
Health diaries

Questions missed (or complete) (dichotomized as incomplete (>20% of questions missed) or complete (≤ 20% of questions missed).

Intervening variables
The following variables were assessed: parents’ age, marital status, education level, ethnic origin, number of children, number of hours per week child is in daycare, number of preschool children, and whether or not the parent worked outside the home.

Analysis
Response rates and completeness rates were compared among groups using the chi-squared test. The agreement between parents’ and nurses’ observations was described in terms of percent agreement and was tested for significance using Pearson correlation. Stratified analyses were carried out, where indicated.

Ethical review
This project was approved by the Human Subjects Review Committee, The University of Western Ontario.

Results

Demographic profile
Twenty-three family physicians from London, Ontario and surrounding counties agreed to participate. Six physicians were randomly allocated to the close follow-up group (CFG), eleven to the telephone follow-up group (TFG), and six to the mail follow-up group (MFG).

A total of 240 parents were entered into the study. Their demographic characteristics are summarized in Table I. The close follow-up group (CFG) differed from the other two groups of parents in being more likely to live in an urban community (p = 0.005) and to have family incomes greater than $60,000 per year (p = 0.007).

Response rate
Of the 240 parents entered into the study, 214 returned the health diary. Table II shows that the CFG had a significantly higher rate than the remaining two groups which had lower (but respectable) response rates and were similar to each other.

Validity
The agreement between parents’ and nurses’ observations at four points in time on the existence of rash, joint pain, cough, and diarrhea are summarized in Table III and varied from 89.9% to 98.7%. Percent agreements fell to 66.6% for the small proportion of participants who were male (i.e., fathers) and divorced.

Redness and swelling were measured by standard sized circles on the transparent reaction ruler. Agreement between diary records and nurses’ observations ranged between 78.5% - 96.2% (Table IV). Again, however, if the parent was male or divorced the agreement decreased to 66.6%.

Axillary temperature was measured by parents using a digital thermometer and by the nurse using a mercury thermometer. Highly statistically significant Pearson correlations ranging from 0.43 to 0.59 (p = 0.001) were observed. Because the range of temperatures was narrow, correlation may not be the best way to assess agreement. Therefore, Table V shows percent agreement within 0.5 degrees centigrade. Agreement ranged from a low 71.6% at 8 hours to 84.6% at Day 7. Because of concern about the relatively low agreement at 8 hours, stratification by level of temperature was done to evaluate whether disagreements were more or less likely to occur at lower or higher temperatures. At higher temperatures (equal or greater than 37.0 degrees centigrade), agreement was lower than at lower temperatures (68.9% vs 73.3%).

Completeness rate
Using the first definition of diary completeness, there were 133 days of missing data out of 4,444 possible days for an incompleteness rate of 2.9%. As to the sec-

TABLE III
Percent Agreement* Between the Parents’ and the Nurse’s Observations of Rash, Joint Pain, Cough, and Diarrhea (n=79)

<table>
<thead>
<tr>
<th></th>
<th>8 hours†</th>
<th>48 hours</th>
<th>Day 7</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rash</td>
<td>97.3%</td>
<td>93.7%</td>
<td>96.2%</td>
<td>96.2%</td>
</tr>
<tr>
<td>Joint pain</td>
<td>94.9</td>
<td>92.4</td>
<td>98.7</td>
<td>N/A</td>
</tr>
<tr>
<td>Cough</td>
<td>92.4</td>
<td>97.5</td>
<td>92.4</td>
<td>89.9</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>98.7</td>
<td>93.7</td>
<td>94.9</td>
<td>92.4</td>
</tr>
</tbody>
</table>

* Agreement was defined as concordance between the parents’ and nurse’s yes/no reports.
† Percent agreement at 8 hours did not differ between higher and lower educated parents (where highly educated was defined as > high school).

TABLE IV
Percent Agreement* Between Parents’ and Nurse’s Measurement of the Size of Redness or Swelling (n=79)

<table>
<thead>
<tr>
<th></th>
<th>8 hours†</th>
<th>48 hours</th>
<th>Day 7</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redness</td>
<td>78.5%</td>
<td>84.8%</td>
<td>96.2%</td>
<td>N/A</td>
</tr>
<tr>
<td>Swelling</td>
<td>73.4</td>
<td>81.0</td>
<td>87.3</td>
<td>92.4</td>
</tr>
</tbody>
</table>

* Redness and swelling were measured by parents and nurse on the reaction ruler. Agreement was defined as ±3 units, e.g., 20 vs. 23 was considered agreement but 20 vs. 30 was not considered agreement.
† Percent agreement at 8 hours did not differ between higher and lower educated parents (where highly educated was defined as > high school).

TABLE V
Percent Agreement* Between Parents’ Temperature Reading and Nurse’s Reading

<table>
<thead>
<tr>
<th></th>
<th>8 hours†</th>
<th>48 hours</th>
<th>Day 7</th>
<th>Day 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>71.6% (74)</td>
<td>82.4% (74)</td>
<td>84.6% (65)</td>
<td>83.6% (61)</td>
</tr>
</tbody>
</table>

* Agreement was defined at within ± 0.5°C.
† Percent agreement at 8 hours did not differ between higher and lower educated parents (where highly educated was defined as > high school).
ond definition of diary completeness, there were a total of 8 diaries missing 4 or more days, giving an incompleteness rate of 3.7%.

Regarding the third definition of completeness (≤20% missing items on the diary in any given week), overall 5.1% (11/214) of diaries were defined as incomplete (Table VI). The only significant difference occurred in week 2, when the CFG group had a higher incompleteness rate compared to the other two groups (13.9%, i.e., 11/79 and 2.2%, i.e., 3/135 respectively). Of all demographic variables shown in Table I, only one was related to completion, i.e., hours in daycare. Children who spent 1-15 hours in daycare had the highest incompleteness rate. Because neither income nor place of residence was related to completeness, no controlled comparisons were required.

Cost
Data collection costs (nurse researcher, mileage, diary kits, research assistant, mail reminders, telephone calls) for the three groups were as follows: CFG, $21,057 total or $266 per completed diary; TFG, $4,002 total or $60 per completed diary; and MFG, $3,252 total or $47 per completed diary.

DISCUSSION

Validity
Few studies have closely examined the validity of the health diary method. The published studies on validity compared the diary responses to: patient interviews at a later point in time;20,21 nurse and physician records;18 child and parent responses on a pain intensity scale;12 and; electromechanical measuring devices and pill counts.10 All studies found health diaries to be valid.

It can be concluded from this study that the health diary is a valid method for acquiring information about the most common types of vaccine-related illness with the possible exception of body temperatures. Information on symptoms, redness, and swelling showed high validity. Temperatures taken by parents were not as accurate when compared to the nurse, especially at 8 hours.

Two possible reasons for the lower agreement at 8 hours are: 1) there could have been a learning effect making agreement higher on subsequent visits; or, 2) the proportion of high temperatures (which were the less accurate temperatures) was greater at 8 hours then at later points in time. The lack of strong agreement on temperature may also have been due to the use of two different measuring instruments, the parents using a digital thermometer and the nurse a mercury bulb thermometer. Reliability of digital thermometers seemed to be very good when tested against mercury thermometers in water-filled beakers. An alternative explanation for the somewhat low agreements may be that parents found it technically difficult to obtain such measurements. The study nurse noted that temperature was very difficult with children frequently squirming and crying. In future studies if temperature data were necessary, training of parents would be required or trained data collectors would need to be used.

Response and completeness rate
The response was highly satisfactory in all three groups. As well, there was no significant difference between the telephone follow-up and mail follow-up groups. Completeness rates were very good ranging between 95% and 97%, depending on the definition. The close follow-up group showed a significant decrease in completeness rates in the second week of the study. This may have been a reflection of the parents assuming that since the study nurse was clearly keeping a close record, they did not need to be so vigilant.

Parents of children spending 1-15 hours per week in daycare across the three follow-up groups, showed a statistically lower completeness rate, but it was still acceptable at 87.5%.

A comparison of cost and response leads one to conclude that the mail follow-up method was the most cost-efficient with the lowest cost per completed diary and the second highest response rate.

Limitations of the study
The close follow-up group were more urban and had higher incomes than the other two groups, casting doubt on the generalizability of the comparison between the nurse and the parents. However, the range of recorded observations did not differ among the three follow-up groups, so it is unlikely that these differences significantly altered the outcomes.

As a whole, the study population was highly educated. Although one might expect completeness rates and response rates to be less satisfactory in populations with less education, we found that education did not influence completeness rates and the percent agreements between the nurse and the parents were almost identical for highly educated compared to less highly educated parents. Some7 have found that those from ethnic minorities had lower completeness rates, but making adaptations for language differences16 and individual abilities17 can mitigate these differences.

CONCLUSIONS

In conclusion, the health diary method is a relatively inexpensive way of gathering a wide range of information about the most common types of vaccine-related illness. However, if accurate temperature data are required, it is recommended that training of parents be undertaken or that another method be used. Future research


References

in this method needs to be directed to its use in a wider variety of settings and translated into different languages to take into account Canadian cultural diversity.

ACKNOWLEDGEMENTS

This joint project was conducted by the National Research System (NaReS) of the College of Family Physicians of Canada, in collaboration with the Thames Valley Family Practice Research Unit (TVFPRU) and supported by the Laboratory Centre for Disease Control (LCDC), Health Canada. The TVFPRU is supported by the Health Systems-Linked Program of the Ministry of Health of Ontario. The views presented here are solely those of the authors and do not represent the policy of the Government of Canada, the views of the Ministry of Health of Ontario, nor the policy of the College of Family Physicians of Canada. The authors wish to thank Ms. Jane Guthrie, research nurse.

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