

Pharmacokinetic Consultation Service Workload Measurement Study

Thomas R. Einarson, Koula Nezis and Michael G. Tierney

ABSTRACT

A study was conducted to collect work measurement data for pharmacokinetic drug consultation services. A stopwatch was used to measure the time required to perform pharmacokinetic consultations in the Ottawa General Hospital, a 530-bed tertiary care teaching hospital.

Ten pharmacists provided 166 drug consults primarily for phenytoin, aminoglycosides, digoxin, and theophylline. The time required to obtain drug level measurements averaged 1.10 minutes. Consults required an average of 8.28 (SD = 4.72) minutes. Initial consults took 10.35 (SD = 5.07) minutes, while repeat consults took 6.62 (SD = 3.67) minutes. The difference was significant ($t = 5.48$, $df = 164$, $P < 0.001$). No significant differences were found among consults for different drugs nor between primary and secondary patient coverage areas. There was a significant difference in the time required to perform a consult among pharmacists. Consult times were considerably less than those reported by the Canadian Hospital Pharmacy Workload Measurement Study.

Key Words: clinical pharmacy, drug monitoring, pharmacokinetics, pharmacy services, time study, work measurement

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RÉSUMÉ

On a mesuré le travail fourni dans le cadre des consultations en pharmacocinétique. Au moyen d'un chronomètre, on a déterminé le temps nécessaire aux consultations offertes à l'Hôpital général d'Ottawa, établissement universitaire de soins tertiaires de 530 lits.

Dix pharmaciens ont donné 166 consultations principalement sur la phénytoïne, les aminosides, la digoxine et la théophylline. Il faut en moyenne 1,10 minutes pour déterminer la concentration du médicament. Les consultations prennent en moyenne 8,28 (É.-T. = 4,72) minutes. La consultation initiale demande 10,35 (É.-T. = 5,07) minutes, tandis que les subséquentes durent 6,62 (É.-T. = 3,67) minutes. La différence est significative ($t = 5,48$, $df = 164$, $P < 0,001$). On n'observe aucun écart significatif entre les temps de consultation pour divers médicaments, ni entre la détermination primaire et secondaire de la concentration chez le patient. Par contre, le temps de consultation varie sensiblement d'un pharmacien à l'autre. Les temps de consultation observés sont considérablement inférieurs à ceux rapportés dans l'étude sur la charge de travail des pharmaciens d'hôpitaux.

Mots clés: étude de temps, mesure du travail, pharmacie clinique, pharmacocinétique, pharmacovigilance, services pharmaceutiques

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INTRODUCTION

The pharmacist's role has been undergoing continuous change since the 1960s. This change has allowed pharmacists to contribute directly to patient care and has resulted in the development of new pharmacy services. The concept of a patient oriented role for the pharmacist has been termed *clinical pharmacy*.

One patient oriented pharmacy service is pharmacokinetic consultation. This service has been shown

to contribute to patient care^{1,2} and to be cost effective.³ However, a recent survey by Einarson and Mann⁴ determined that only 42 out of 130 responding hospitals in Canada (32.3%) provided formal pharmacokinetic consultation services. Therefore, patients in many facilities have not been receiving optimal benefits that pharmacy is capable of providing.

In order to implement a clinical pharmacy service, financial sup-

port must be secured from hospital administration. In this time of fiscal restraint, it is essential that hospital pharmacy directors have accurate data with which to estimate staffing requirements for expanded services.⁵ The Pharmacy Workload Measurement System⁶ was developed to provide a method for generating such data.

The Canadian Hospital Pharmacy Workload Measurement System (CWMS) was carried out

in thirteen hospitals across Canada. As a prerequisite for inclusion in the study⁵ institutions were required to meet the Standards of Canadian Hospital Pharmacy Practice.⁷ However, the hospitals varied in size, administrative organization, number of pharmacy services provided, and pharmacy systems utilized. In addition, they were representative of different geographical areas. The study utilized specific methods of observation and measurement, followed a patient selection protocol, adopted specific requirements for the breakdown of each pharmacy service into elements which could be measured, as well as a specific data collection and analysis of data methods.

The requirements of the CWMS were impractical for application to the present study. Also, the focus of this project was not on the work time of individual elements of the pharmacokinetic drug monitoring process, but in the *total* time required to perform the consultation. Furthermore, it is recognized that the majority of pharmacy work does not proceed in an orderly and distinctive manner progressing from one activity to the next.⁵ Therefore to divide the pharmacokinetic drug monitoring process into several distinct activities would render it impractical for use in a work measurement system. This is especially true when an external observer is not available to perform the work measurement.

This study was undertaken to provide pharmacy administration with data that would quantify the amount of clinical practice time spent during an average pharmacokinetic consult. It was hoped that this research could provide other hospitals with data that could be useful in establishing a pharmacokinetic consultation service. Another useful outcome would be an

increase in the amount of data presently available on workload measurement studies pertaining to pharmacokinetic consultation services.

The specific objectives of the study were:

- 1) to determine the time involved in performing pharmacokinetic consultations;
- 2) to determine if a significant difference existed between the time required to perform an *initial consultation* and a repeat consultation;
- 3) to determine if a significant difference existed between the time required to perform a pharmacokinetic consultation in a *primary patient coverage area* and that in a *secondary patient coverage area*;
- 4) to determine if a significant difference existed among pharmacists in the time required to perform pharmacokinetic consultations; and
- 5) to determine if a significant difference existed between the time required to perform a pharmacokinetic consultation among the various drugs used in this study.

METHOD

The study was conducted at the Ottawa General Hospital (OGH), a 530-bed tertiary care teaching institution. The research was carried out over a three week period, February 8-26, 1988. The OGH pharmacy department consisted of fifteen staff pharmacists and three administrative pharmacists, who also performed clinical functions. They utilized a team concept where each team, composed of three to four pharmacists, was assigned to specific wards. The team members rotated through each of these wards and one of the functions of the pharmacists was to monitor serum drug concentrations

(SDC) and perform pharmacokinetic drug consultations. There were eighteen pharmacists in total who performed pharmacokinetic consultations.

The sample consisted of all pharmacist activities associated with all SDC for OGH patients who were being monitored by the designated pharmacists during the study. A minimum of ten pharmacists participated in the study. The anticipated number of consultations which would constitute the sample size was 200. The pharmacists were volunteers who participated in the study in addition to performing their normal clinical functions and received no additional remuneration for their participation.

Recording times (in seconds) for the actual project were determined using a stop watch. Each afternoon the SDC results arrived in the pharmacy department on data sheets from the biochemistry laboratory and were placed in a designated area termed the pharmacokinetic counter. The monitoring pharmacists were then responsible for collecting data pertaining to their patients on their assigned wards. Data could be collected during several intervals depending on how frequently the results arrived in the pharmacy. The pharmacist first collected all the required patient information from the pharmacokinetic counter where the levels were received in the pharmacy department. Included were the number of minutes required to perform activities related to obtaining the values for the drug level measurements from the pharmacy department which have been provided by the laboratory (e.g., the times the levels were drawn, the values of the drug blood levels, patient's name). This was the time required to *Obtain Levels*. The watch was stopped and the phar-

macist proceeded to the ward. Once the pharmacist arrived on the ward, he/she started the stopwatch when he/she was prepared to begin the *Pharmacokinetic Consultation* process. The entire processes of patient review, formulation of further drug therapy recommendations, calculations, and actual consult writing were to be performed during this time. One would normally have expected these actions to be recorded separately, however, since doing so would have created much confusion and risked producing inaccurate data, it was decided that total time would be measured. Once the pharmacist finished the consult, he/she stopped the stopwatch and recorded the time (in seconds) required to perform these processes. The pharmacist then filled in all the information requested on the survey sheet. No time measurement was required for this exercise. The stopwatch was reset to zero for the next consult.

The method utilized in determining these times was direct measurement by stopwatch timing by the pharmacists completing the consult. As in the CWMS, nonproductive and idle time was not included in the measurements and was excluded from the study. This approach was considered reasonable since each hospital policy determines the percentage of personal fatigue and delay time allowed to its staff. Travel time was omitted from the study; communication time (i.e., with the patient, physician, or nurse) was incorporated into the patient review.

Limits were set for the recording times, so that consultations below the five minute lower limit and above the thirty minute upper limit were considered unusual. If unusual cases listed any of the following explanations they were excluded:

- a) the patient was well known to the pharmacist, so only a cursory examination of data was done (< 5 minutes);
 - b) the patient's status changed i.e., the patient was discharged when the pharmacist arrived on the ward (< 5 minutes);
 - c) the patient's chart was not available for preparing the written consultation, thus only a verbal consult was performed with the physician (< 5 minutes);
 - d) random levels were not appropriate for assessment (< 5 minutes); and
 - e) team contact was necessary to withhold and reassess the use of the medication (>30 minutes).
- This requirement was enforced in order to exclude extraneous data which would have falsely skewed the results.

In order to meet Objective #1 descriptive statistics were used. Included were the average number of minutes taken to perform a consult, standard deviation, and range of times. To determine whether initial consults differed from repeat consults, Student's t test was performed between the respective recording times. To compare time required for consults in pharmacists, primary and secondary patient coverage area, Student's t test was performed between those recording times. A primary patient coverage area was a medical service area which was provided with a full range of pharmacy services; thus the patient underwent more intense pharmacy monitoring (e.g. intensive care). It included the following activities: patient medication history interviews, drug therapy monitoring, pharmacokinetic consultation, patient drug education, provision of drug information services, inservices, drug utilization review involvement, regular patient rounds

with physicians, and training of pharmacy residents.

A secondary patient coverage area was a medical service which required drug monitoring and clinical pharmacy services that were less intense than those provided in primary patient coverage areas (e.g. ophthalmology). Routine activities on secondary patient coverage areas included nursing Kardex reviews, pharmacokinetic consultations, and patient counselling on request. All other activities were of a "trouble-shooting" nature. Consequently, the pharmacists were less familiar with patients on a secondary patient coverage area as compared to patients on a primary patient coverage area.

In order to compare the recording times of the ten pharmacists, data were analyzed using a one way analysis of variance (ANOVA). Similarly, consult times among different drugs were contrasted using a one way ANOVA. A level of $p < 0.05$ was accepted as significant for all the statistical tests.

RESULTS

A total of ten pharmacists participated in the study which was carried out over a period of fifteen days. As shown in Table I, the total number of SDC drawn and recorded was 185; however, only 166 consults were written. The mean recording time for all pharmacists was 8.28 (SD = 4.72) minutes. Only 165 cases were used in the analysis and reported in this table because one pharmacist performed a single consult and therefore (since a single observation has no variance) this value could not be included in the ANOVA.

Tables I, II and III present: means, standard deviations and ranges of time values determined in this study. There was a wide variation in time required to per-

form the pharmacokinetic drug monitoring. Table II lists the total number of consults performed for each of the drugs studied. Drugs investigated were phenytoin, aminoglycosides, digoxin, theophylline, and others. Table III shows the total number of consults performed by each pharmacist as well as the average recording time for each pharmacist.

Pharmacists required an average of 5.81 ± 3.31 minutes to process data sheets. However, data sheets most often recorded more than one level. Thus, the average amount of time taken to obtain drug level measurements was 1.10 minutes per consult. This value was obtained by dividing the total number of minutes by the total number of levels recorded.

That is,
(35 data sheets x 5.81 minutes/data sheet)

185 levels

= 1.10 minutes/level.

The average time taken to perform a pharmacokinetic consult (i.e. recording time) was found to be 8.28 (SD = 4.72) minutes. No results exceeded the thirty minute upper limit and all of the results were included in the analysis.

The mean time taken for an *initial consult* was 10.35 (SD = 5.07) minutes, whereas pharmacists required 6.62 (SD = 3.67) minutes to perform a *repeat consult*. These means were contrasted using Student's t test which indicated a significant difference ($t = 5.48$, $df = 164$, $p < 0.001$).

Table I presents the *primary* and *secondary* patient coverage area results which had means of 8.26 (SD = 4.46) minutes and 8.30 (SD = 5.07) minutes, respectively. These means were contrasted using Student's t test, which found no significant difference, ($t = 0.05$, $df = 164$, $p = 0.959$).

Analysis of variance was also utilized to detect differences in the

time required to perform a pharmacokinetic consultation among drugs. There was no significant difference revealed (see Table II), ($F = 0.41$, $df = 4$, 161 ; $p = 0.803$). Therefore, no difference is expected in the recording times of different drugs since consultations consume approximately the same amount of time.

Analysis of variance was utilized

to detect differences in the recording time per consultation among pharmacists (see Table III). This test revealed significant inter-pharmacist variation in the time required to perform a pharmacokinetic consult ($F = 2.07$, $df = 8$, 156 ; $p = 0.042$). Means between individual pharmacists were significantly different for time exceeding 4.41 minutes.

Table I: Time in minutes required for pharmacists to complete pharmacokinetic consults

Variable	n	mean	SD	range	P value
Obtain Levels*	185	5.81	3.31	1.7 - 15.1	
Pharmacokinetic Consultations	165	8.28	4.72	1.5 - 28.0	
a) Initial	74	10.35	5.07	1.7 - 28.0	0.001
Repeat	92	6.62	3.67	1.5 - 19.2	
b) Primary	95	8.26	4.46	1.5 - 24.1	0.959
Secondary	71	8.30	5.07	2.1 - 28.0	

* Time for levels refers to the amount of time taken to note patient data related to drug levels (value of level, time drawn, patient's name, sex, etc.) after delivery of data to the pharmacist.

Table II: Time in minutes taken to perform consults for each drug*

Drug	n	mean	SD	range
phenytoin	29	8.67	4.72	2.1 - 20.8
aminoglycosides	35	8.58	5.60	1.7 - 28.0
digoxin	32	8.55	3.71	1.5 - 21.6
theophylline	44	8.20	5.00	2.1 - 24.1
other**	26	7.26	4.19	2.2 - 19.2

* no significant difference among drugs ($F = 0.41$; $df = 4$, 161 ; $p = 0.803$).
** Other drugs included: lithium, carbamazepine, phenobarbital, vancomycin, procainamide, valproic acid, primidone.

Table III: Times in minutes taken by individual pharmacists to perform pharmacokinetic consults*

Pharmacist	n	mean	SD	range
1	43	6.78	3.98	2.2 - 19.0
2	1	10.17	0	-
3	29	8.37	2.95	3.3 - 17.4
4	21	7.81	3.48	3.3 - 14.2
5	40	10.20	5.73	2.0 - 24.1
6	2	5.67	5.66	1.7 - 9.7
7	8	9.21	5.14	2.2 - 16.3
8	6	6.37	3.44	2.7 - 10.8
9	3	4.39	4.16	1.5 - 9.2
10	13	9.35	6.91	3.6 - 28.0

* $F = 2.07$, $df = 8$, 15 ; $p = 0.042$.
Significant difference = 4.41 (Scheffe method).

DISCUSSION

The research provided average time values associated with two major subdivisions of the pharmacokinetic drug monitoring process, namely: 1) obtaining drug level measurements; and 2) the pharmacokinetic consultation process. In comparison to the CWMS which involved direct observation of pharmacists by an external observer and recorder, this study required the pharmacists to record their activity times. It was impractical for the scope of the study to divide the pharmacokinetic drug monitoring process into more than two categories. Furthermore the method employed by the CWMS would be difficult to apply to the service at the OGH. One reason is that the OGH pharmacists obtained much of the patient related information required for performing pharmacokinetic consults during other clinical activities (e.g. morning rounds with physicians on the wards).

The present study determined the average time required to obtain drug level measurements for one drug to be 1.10 minutes. This value is similar to that of 1.98 minutes reported in the CWMS (see Table IV). This study revealed a significant difference in the time required to perform a pharmacokinetic consult between initial and repeat consults. One explanation is that the pharmacists were more familiar with their patients during the repeat consults as opposed to the initial consults. There was no significant difference revealed between the time required to perform a pharmacokinetic consult in a primary patient coverage area and that in a secondary patient coverage area. Further research is required to determine the reason for this finding.

There was no significant difference between consult recording

Table IV: Work measurement values reported by the CWMS* for pharmacokinetic drug monitoring

Element	n	average unit value (min)	95% confidence interval (sec)	range of unit values (sec)
chart review	57	8.44 ^a	387.6 - 625.2	76.0 - 2035.0
obtain levels	53	1.98	86.5 - 150.5	43.0 - 255.0
pharmacokinetic calculation per patient	57	8.93	414.5 - 657.1	106.7 - 1146.0
pharmacokinetic calculation per drug level	82	6.21 ^b	267.1 - 477.7	106.7 - 1146.0
pharmacokinetic consultation	18	6.26 ^c	319.7 - 431.3	241.0 - 627.0
communication**	-	12.5%	7.2 - 17.8%	0 - 42.6%
travel**	-	17.1%	13.0 - 21.2%	6.8 - 36.0%

* Canadian Hospital Pharmacy Workload Measurement Study.⁶
 ** These data are expressed in percentages (%) and not in minutes and seconds, as other data in this table.
 NOTE: The sum of the average unit values of a, b, and c plus the 12.5% communication time was 20.91 minutes + 12.5% (i.e., 23.52 minutes). That value represents the equivalent of this study's average "Pharmacokinetic Consultation time", which was found to be 8.28 minutes (SD = 4.74).

times for the various drugs. Since there should be no difference in the consult processes of the various drugs except the calculations, then this would be the critical factor influencing recording times. However, no significant difference was found, consequently, it may be suggested that the calculation processes for the various drugs consumed approximately the same amount of time.

The variability in the time required by the pharmacist to perform the processes of pharmacokinetic drug monitoring depends on many factors. This variability may be primarily a function of the individual's technique, style, and ability. Another possible reason for the dissimilarity between pharmacists' recording times could be the patient mix that each pharmacist encountered. Finally, the type of pharmacokinetic consult service and the number of pharmacists involved in the program at each hospital could influence the time differences among pharmacists.

The definition of "Chart review" for the CWMS was "work activities related to ... information on a monitoring form".⁶ Most of these processes were not actually included at the time the consult was performed in this study. For instance, the time the blood samples were drawn was recorded during the time required to obtain drug level measurements since this is included with the lab results. The medication administration schedule, diagnosis and patient's general condition are most probably already known by the pharmacists, due to the OGH team concept work design. Information such as height and weight are generally irrelevant to the patient's condition unless they are extremes. Finally, documentation of all of this information on a monitoring form is not performed for each patient consult since each consult sheet is Addressographed once and more than one consult may be written and dated on this form.

The aforementioned reasons are

not exhaustive of those which can be used to explain the different time results found between the CWMS and this study. Some other possible explanations for this dissimilarity are: a) the OGH team concept system facilitated work processes associated with pharmacokinetic drug consultations; b) no programmable calculators or computers were used in the calculation process of the consult at the OGH, which means time savings; c) the OGH operated on the Friesen hospital system which allowed for easy access to the patient's medication chart and the dosage administration schedule which were at the patient's bedside; and d) in most cases, the pharmacists at OGH were familiar with the patient's condition thereby minimizing the time required to review the chart.

Finally the fact that an external observer was utilized in the CWMS may have influenced their subjects' performance. It is possible that the pharmacist's worktime was increased because of an increased degree of caution on the pharmacists' part (i.e. due to being observed). On the other hand, the use of a single (self) observer could have produced a systematic bias in our data, resulting in differences.

As mentioned earlier, this study did not include the travel time component of the pharmacokinetic drug monitoring procedure. This component must be taken into consideration when using the data. Travel time may vary extensively between and within hospitals depending on physical layout and on the operational design of the pharmacy services.

CONCLUSIONS

This study attempted to analyze those components of the OGH pharmacokinetic consultation service which substantially influence the amount of time spent in such a service. The results showed that in a hospital setting such as the OGH, with team concept services, that initial consults required a significantly greater amount of time to perform than repeat consults. Furthermore the pharmacists performing the consults varied significantly in the time required to perform them. The other variables studied were not significantly important to the time spent in a consult service. Thus if other pharmacy departments wish to implement a pharmacokinetic consultation service, this study provides valuable data that quantify the time spent in performing such a service. ❧

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