PHARMACY PRACTICE

Implementation and Evaluation of a Therapeutic Drug Level Requisition

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INTRODUCTION

In September 1989 a new Therapeutic Drug Level Requisition (Figure 1) was implemented as a replacement for the Laboratory General Purpose Requisition (Figure 2) which was previously utilized for serum drug concentrations (SDC's) at the Plains Health Centre, a 303-bed acute care hospital in Regina. There were six proposed advantages of the new form over the General Purpose Requisition.

1. Ensures the therapeutic range of the drug is recorded.
2. Ensures the correct number of samples are collected.
3. Ensures the correct sampling times.
4. Provides the dosage regimen on the same form as the SDC results.
5. Provides guidelines outlining when to draw samples for SDC's relative to when the dose is administered.
6. Provides the scheduled dosing administration times.

The therapeutic ranges for each drug and the guidelines outlining when to draw the plasma samples relative to the administration of a dose were compiled from selected references.[1-8] A detailed table of this information was provided to the laboratory and was printed in the hospital formulary. For many drugs, the timing of the plasma sample collection relative to dosage administration is important in the interpretation of the SDC's as outlined in a previous study where only 54% of plasma drug samples were drawn at the recommended times.[9]

In order to determine whether or not these advantages are being achieved with the new form, a prospective audit was performed by the Pharmacy Department.

IMPLEMENTATION AND EVALUATION

Prior to the implementation of the new requisition, patients who had a SDC assay performed were randomly selected for the audit by prospectively reviewing laboratory records over a two-week period in July and August 1989. The random selection of patients was based on the availability of time each day to collect data until 35 to 45 patients were included in this part of the study. Patient charts were reviewed and data was collected on a SDC Audit Form. Aminoglycoside (e.g. gentamicin and tobramycin) SDC's were excluded since they were monitored through the aminoglycoside pharmacokinetic protocol of the institution. Also, SDC's ordered for patients in the Emergency Department and "stat" SDC's were excluded from the data collection.

The new therapeutic Drug Level Requisition was developed by the Pharmacy Department and implemented after approval by the Laboratory, Pharmacy Committee, Medical Advisory Committee and Health Records Committee. Implementation was preceded by a memo sent to all nursing units and an article in the pharmacy newsletter distributed to physicians and nursing units. In addition, inservices were provided to unit clerks, nurses, Assistant Directors of Clinical Nursing, laboratory technicians and phlebotomists on the use of the new form.

One month after the new form was implemented, patients who had a SDC assay performed were randomly selected for the audit until 35 to 45 patients were included in this part of the study. Due to time limitations this process required six weeks from October to December 1989. Aminoglycoside SDC's, "stat"

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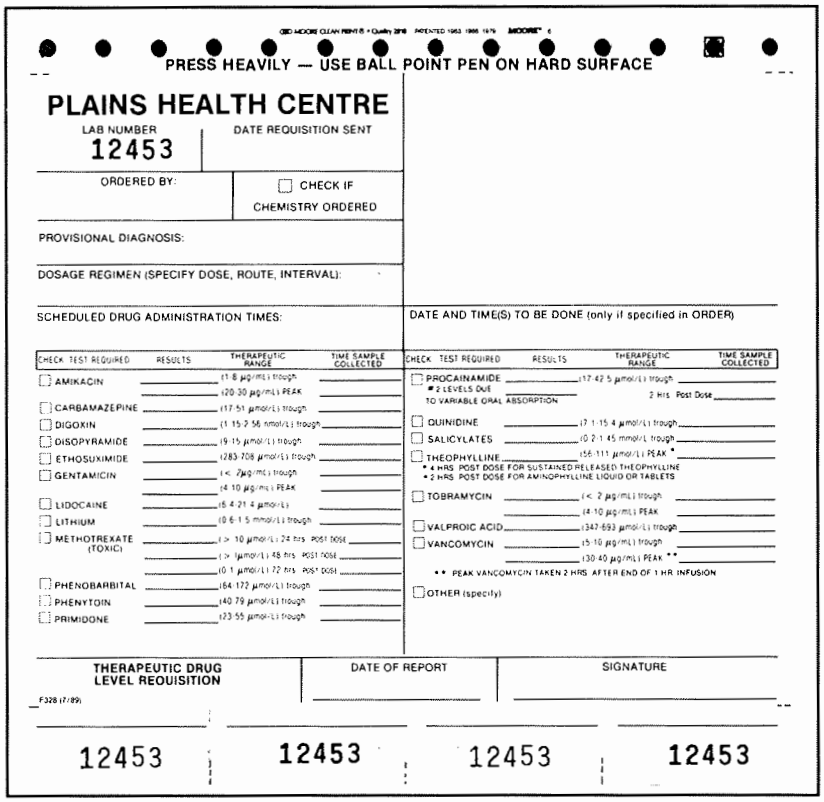
SDC's and SDC's ordered for patients in the Emergency Department were excluded from the data collection.

During the first audit period (before the new form was implemented) 44 SDC Audit Forms were completed. The results are outlined in Table I; in some cases the criteria were not applicable. During the second audit period, after the new form was implemented, 35 SDC Audit Forms were completed. In three cases (nine percent), the Laboratory General Purpose Form was used instead of the new form. The results of the audit outlined in Table I are based on the data collected from the 32 cases where the new form was used. In some cases the criteria were not applicable.

DISCUSSION

The new Therapeutic Drug Level Requisition provides some advantages over the form which was previously used. In particular, the new form ensures that the therapeutic range is recorded and helps to ensure that the dosage regimen received when SDC's were taken is also recorded. In addition, the new form was implemented to help ensure that samples are collected at appropriate times relative to dose administration. The results of this audit demonstrated an improvement from 37 percent (pre-implementation) to 76 percent (post-implementation) with respect to this criterion. The drug most frequently implicated with incorrect sampling time was theophylline, which was also most frequently associated with non-compliance in recording scheduled dose administration times. This suggests that there may be even greater improvement in the collection of the samples if the new forms are completed correctly. No specific area of the hospital was associated with a high incidence of incomplete or improperly completed requisitions.


PRESS HEAVILY — USE BALL POINT PEN ON HARD SURFACE

PLAINS HEALTH CENTRE

LAB NUMBER 12453 | DATE REQUISITION SENT

ORDERED BY: | ☐ CHECK IF CHEMISTRY ORDERED

PROVISIONAL DIAGNOSIS:

DOSAGE REGIMEN (SPECIFY DOSE, ROUTE, INTERVAL):

SCHEDULED DRUG ADMINISTRATION TIMES:

DATE AND TIME(S) TO BE DONE (only if specified in ORDER)

CHECK	TEST REQUIRED	RESULTS	THERAPEUTIC RANGE	TIME SAMPLE COLLECTED
☐	AMIKACIN		(1-8 µg/mL) trough	
			(20-30 µg/mL) PEAK	
☐	CARBAMAZEPINE		(17-51 µmol/L) trough	
☐	DIGOXIN		(1.15-2.56 nmol/L) trough	
☐	DISOPYRAMIDE		(3-15 µmol/L) trough	
☐	ETHOSUXIMIDE		(283-708 µmol/L) trough	
☐	GENTAMICIN		(< 2µg/mL) trough	
			(4-10 µg/mL) PEAK	
☐	LIDOCAINE		(6.4-21.4 µmol/L)	
☐	LITHIUM		(0.6-1.5 mmol/L) trough	
☐	METHOTREXATE (TOXIC)		(> 10 µmol/L) 24 hrs. POST DOSE	
			(> 1µmol/L) 48 hrs. POST DOSE	
			(0.1 µmol/L) 72 hrs. POST DOSE	
☐	PHENOBARBITAL		(64-172 µmol/L) trough	
☐	PHENYTOIN		(40-79 µmol/L) trough	
☐	PRIMIDONE		(23-55 µmol/L) trough	

CHECK	TEST REQUIRED	RESULTS	THERAPEUTIC RANGE	TIME SAMPLE COLLECTED
☐	PROCAINAMIDE # 2 LEVELS DUE TO VARIABLE ORAL ABSORPTION		(17-42.5 µmol/L) trough	
			2 hrs. Post Dose	
☐	QUINIDINE		(7.1-15.4 µmol/L) trough	
☐	SALICYLATES		(0.2-1.45 mmol/L trough	
☐	THEOPHYLLINE * 4 HRS POST DOSE FOR SUSTAINED RELEASED THEOPHYLLINE * 2 HRS POST DOSE FOR AMINOPHYLLINE LIQUID OR TABLETS		(56-111 µmol/L) PEAK *	
☐	TOBRAMYCIN		(< 2 µg/mL) trough	
			(4-10 µg/mL) PEAK	
☐	VALPROIC ACID		(347-693 µmol/L) trough	
☐	VANCOMYCIN		(5-10 µg/mL) trough	
			(30-40 µg/mL) PEAK **	

** PEAK VANCOMYCIN TAKEN 2 HRS. AFTER END OF 1 HR. INFUSION

☐ OTHER (specify)

THERAPEUTIC DRUG LEVEL REQUISITION | DATE OF REPORT | SIGNATURE

F328 (7/89)

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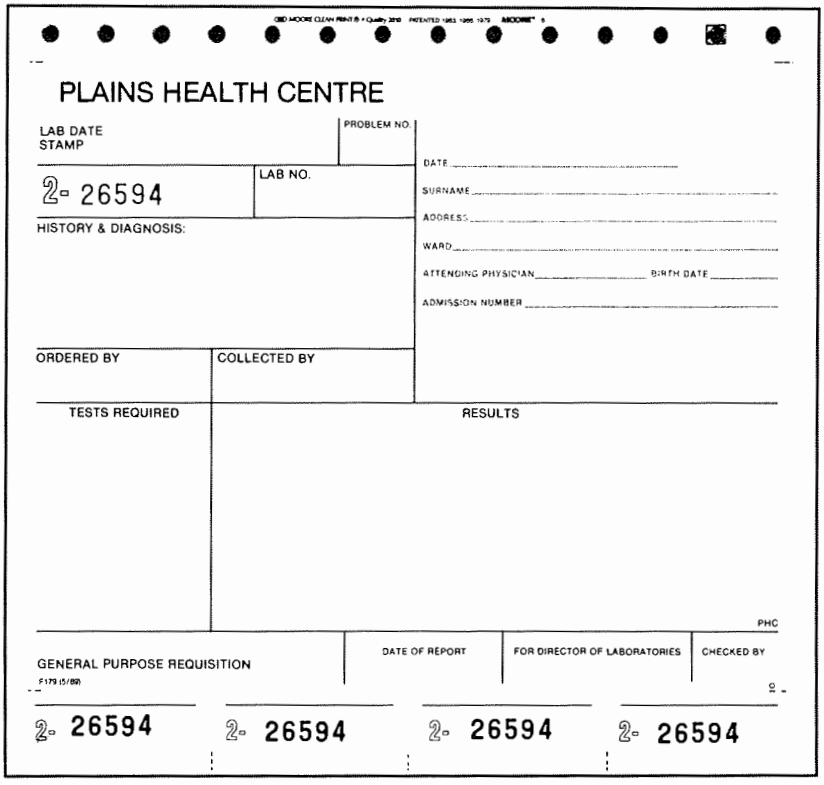
Figure 1: Therapeutic Drug Level Requisition

Table I: Comparison of Pre-Implementation and Post-Implementation Audit Results

Criteria	Pre-Implementation Compliance	Post-Implementation Compliance
Therapeutic range recorded	48%	100%
Correct number of samples collected	98%	97%
Correct sampling times (+/- 30 min)	37%	76%
Dosage regimen recorded	0%	90%
Guidelines specified for drawing levels	0%	100%
Scheduled administration times recorded	0%	90%

The Therapeutic Drug Level Requisition does not ensure that SDC's are taken at steady state. Combined data from the pre and post-implementation audits revealed that steady state was achieved for 72 percent of SDC's. Ensuring that SDC's are obtained at steady state (and at the correct time relative to dose administration) could be accomplished by having a pharmacist complete the form and indicate the date and time for samples to be collected. Currently our Pharmacy Department does not have the staff to implement this procedure. Compliance with collecting the correct number of samples was excellent before (98 percent) and after (97 percent) the new form was imple-


PLAINS HEALTH CENTRE

LAB DATE STAMP

PROBLEM NO.

LAB NO.

2- 26594

DATE

SURNAME

ADDRESS

WARD

ATTENDING PHYSICIAN

BIRTH DATE

ADMISSION NUMBER

HISTORY & DIAGNOSIS:

ORDERED BY

COLLECTED BY

TESTS REQUIRED

RESULTS

PHC

GENERAL PURPOSE REQUISITION

DATE OF REPORT

FOR DIRECTOR OF LABORATORIES

CHECKED BY

2- 26594 2- 26594 2- 26594 2- 26594

Figure 2: Laboratory General Purpose Requisition

mented. This was likely because most drugs involved in the audit require a single SDC.

It is difficult to attach a dollar value to the improvements seen with the new form. If one considers a SDC to be of limited value if the sample is collected at an inappropriate time relative to does administration, then 63 percent of the SDC's for samples collected before implementation of the new form fall into this category. Based on a 10-day review of drug levels ordered in March, 1990 and assuming that SDC ordering frequency does not change, approximately 3,000 SDC's are performed each year (excluding aminoglycoside SDC's, "stat" SDC's and SDC's ordered in the Emergency Department) at a cost of $10,350. If 63 percent ($6,520) of SDC's were of limited value using the old form compared to 24 percent ($2,484) with the new form, then $4,036 is saved annually by implementing the new Therapeutic Drug Level Requisition. If this form is used 100 percent correctly, it could save $6,520 per year. These are conservative estimates and do not take into account that not all SDC's were taken at steady state.

The cost of printing the new forms is negligible since the use of a new form replaces the use of an old form. The time spent developing and implementing the form was not more than 75 man-hours. This cost would easily be offset within the first few months of implementation. It is conceivable that the educational component of introducing the new form, rather than the form itself, may have contributed to some of the audit results; however, without dedicated space on the form for items such as dosage schedule and therapeutic range, it is unlikely that education alone would have worked nearly as well.

A similar form was also introduced at the Pasqua Hospital, which along with the Plains Health Centre, comprises the South Saskatchewan Hospital Centre. Data collected there following implementation was also encouraging.

The development and implementation of a Therapeutic Drug Level Requisition is a relatively easy and non labour-intensive method of improving the usefulness of SDC assays. Ideally a pharmacist should be scheduling the date and time SDC's are to be performed, then evaluating the SDC's and recommending necessary changes in dosage regimens to physicians. Unfortunately many Pharmacy Departments, including ours, are unable to provide this service for all SDC's ordered. The implementation of a Therapeutic Drug Level Requisition is perhaps a compromise, but can have a positive impact with minimal effect on staffing requirements.

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