

Establishment of a Bone Marrow Transplant Satellite Pharmacy

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ABSTRACT

The planning, establishment and operation of a bone marrow transplant (B.M.T.) satellite pharmacy in a 1100-bed teaching hospital are described.

The B.M.T. satellite pharmacy was established because of the specialized pharmaceutical care needs of this patient population with a high risk for drug-related problems. The satellite pharmacy, which is located within a 19-bed Oncology Unit, provides integrated clinical-distributive services (unit-dose, IV-admixture system) to all B.M.T. patients. The satellite is open 10.5 hours per day, seven days per week. Staff consists of three full-time equivalent (F.T.E.) staff pharmacists, a 0.5 F.T.E. technician, and one F.T.E. clinical pharmacist. Staff pharmacists rotate between provision of B.M.T. pharmacy services, and provision of pharmacy services for the provincial Home Parenteral Nutrition program. The pharmacists are responsible for all aspects of drug distribution and clinical services for B.M.T. patients. Additional drug distribution and clinical services are provided to other Oncology Unit patients.

The establishment of a satellite pharmacy has provided unique opportunities for pharmaceutical care of the B.M.T. patient.

Key Words: bone marrow transplantation, pharmaceutical care, satellite pharmacy

Can J Hosp Pharm 1993;46:5-11

RÉSUMÉ

On décrit la planification, la mise en oeuvre et le fonctionnement d'une pharmacie satellite créée à l'intention des patients qui ont subi une greffe de moelle osseuse dans un hôpital d'enseignement de 1 100 lits.

Le service satellite a été établi en raison des soins pharmaceutiques spécialisés qu'exigent les malades qui reçoivent une greffe de moelle osseuse et du risque élevé de complications associé à la pharmacothérapie. Située dans un service d'oncologie de 19 lits, la pharmacie satellite offre des services cliniques et de distribution intégrés (dose unitaire, d'additifs aux solutés) à tous les malades qui ont subi une greffe de moelle osseuse. Elle est ouverte 10,5 heures par jour, sept jours par semaine. Le personnel comprend trois pharmaciens équivalents temps plein, 0,5 technicien équivalent temps plein et un pharmacien clinicien équivalent temps plein. Les pharmaciens fournissent à tour de rôle des services pharmaceutiques à l'unité de greffe de moelle osseuse et dans le cadre du programme provincial de nutrition parentérale à domicile. Les pharmaciens sont responsables de tous les aspects de la distribution des médicaments et des services cliniques à l'intention des greffés. De plus, ils fournissent des services de distribution de médicaments et des services cliniques à d'autres patients du service d'oncologie.

L'établissement d'une pharmacie satellite constitue une occasion unique de fournir des soins pharmaceutiques spécialisés aux patients qui ont subis une greffe de moelle osseuse.

Mots clés: greffe de moelle osseuse, pharmacie satellite, soins pharmaceutiques

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Acknowledgments: The expert secretarial assistance of Michelle Jubenvill is gratefully acknowledged.

This project was presented at the 18th Annual CSHP Western Branches Banff Seminar, Banff, Alberta, March 20, 1992.

INTRODUCTION

Pharmaceutical care describes a patient-pharmacist relationship that aims to improve a patient's quality of life through responsible provision of drug therapy.¹ A con-

tinuum of pharmaceutical care is typically provided by hospital pharmacy services.² The process of drug order review and patient profile review enables the pharmacist to provide a basic level of phar-

maceutical care. With access to both the patient and patient-specific parameters, the number, type and complexity of drug-related problems that can be detected, prevented and resolved

should increase substantially.

Experience in three critical care pharmacy satellites at the Health Sciences Centre (H.S.C.) has demonstrated that optimal pharmaceutical care of high-risk patients is best provided by pharmacists functioning in an integrated distributive — clinical role.³ Critical care patients have been identified as a population with a high risk for drug-related problems because of medical conditions or drug treatment regimens with specific characteristics (Table I). Bone marrow transplant patients share these characteristics. Bone marrow transplantation involves the administration of high-dose chemotherapy to eradicate tumor or prepare a space in the marrow cavity for new cells to grow. Bone marrow collected from the patient before high-dose chemotherapy (autologous), or collected from a genetically similar donor (allogeneic) is infused into the patient, and engraftment of the marrow ensues. The B.M.T. patient is at risk for life-threatening infection and graft-related complications, particularly within the first 100 days after transplant.⁴

A proposed program for adult and pediatric B.M.T. prompted pharmacy administrators to review the pharmaceutical care needs of B.M.T. patients. This report describes the establishment of a B.M.T. satellite pharmacy which provides comprehensive pharmaceutical care in a patient population with a high risk for drug-related problems.

Background

The H.S.C. is an 1100-bed university affiliated tertiary care teaching hospital. The H.S.C. provides major referral services for adult, pediatric and neonatal patients. In addition, the H.S.C. has a close working relationship with the Manitoba Cancer Treatment and Re-

Table I. Criteria for patients with a high risk for drug-related problems

- A need for multiple medications to control multi-system disorders.
- A need for potent medications with narrow therapeutic indices.
- Medications given in maximal dosages, or exceeding usual maximum dosages.
- Medications given predominantly by the intravenous route due to:
 - a) inability to absorb drugs reliably from the gastrointestinal tract,
 - b) a need for rapid onset or termination of drug action, or
 - c) need for a drug that is inactive by the oral route.
- A need for critical fluid/electrolyte management, and, therefore, for delivery of concentrated or customized drug solutions.
- High risk for drug interactions/incompatibilities and delay of drug delivery due to complicated medication administration schedules or limited venous access.
- Patient instability requiring urgent or emergency drug therapy.
- A need for unusual or investigational drug therapies for which information may be scarce.
- Patients with abnormalities of drug metabolism, elimination or distribution.

search Foundation.

The pharmacy department provides both central pharmacy and satellite pharmacy services. Three 24-hour satellite pharmacies provide a complete unit-dose drug distribution system, an intravenous admixture program and clinical services in the adult medical intensive care and coronary care units, the neonatal intensive care unit and the pediatric intensive care unit. In all other areas of the centre, a combination of individual prescription and ward stock drug distribution services are provided. The central pharmacy prepares total parenteral nutrition (T.P.N.) and oncology admixtures for all patients. Selected sterile products are prepared in the central pharmacy for patients outside of critical care areas.

Before the B.M.T. satellite pharmacy was established on the adult Oncology Unit, drug distribution services were supplied through the central pharmacy. Clinical pharmacy services were limited to consultations by the infectious disease clinical pharmacist, and to drug information services provided through the central pharmacy.

Development of a Pharmacy Service Proposal

When the need for a Manitoba

B.M.T. program was identified, a B.M.T. Planning Committee, which included hospital administration, medicine, nursing, pharmacy and provincial government representatives, was established. The committee identified departments and services that might be affected by the B.M.T. program, and service proposals with an estimate of required resources were solicited. The B.M.T. program was to begin with four beds in the first year, accommodating 24 cases per year, and would increase by the fourth year to six beds, accommodating 43-54 patients per year. These beds were to be allocated from the 19 beds that existed within the adult Oncology Unit.

Two hospitals with established autologous and allogeneic B.M.T. programs were identified as resource centres. Their assistance was sought regarding drug, supply and personnel costs associated with the services listed in Table II. Extrapolating this information to the proposed H.S.C. program provided initial estimates of drug costs. Human resource requirements were estimated from the full-time equivalent (F.T.E.) to bed ratio from the resource hospitals, and Pharmacy Workload Measurement System calculations for

Table II. Desirable pharmacy services for bone marrow transplant patients

Antineoplastic admixture services
Intravenous admixture services for all other parenteral drugs
Total parenteral nutrition services
Unit-dose drug distribution services for non-parenteral drug therapy
Investigational/emergency drug services
Drug information services

Table III. Incremental staff and operating costs comparison for integrated clinical-distributive pharmacy service options (Year 1 of program)

	Option 1	Option 2	Option 3	Option 4	Option 5
Staff (F.T.E.)					
Pharmacist	7.4	3.0	7.4	3.0	0
Technician	3.0	0.9	3.0	0.9	0
ClinPharm ^a	0.5	0.5	0.5	0.5	0
Messenger	0	0	3.0	3.0	0
Nurse ^b	0	0	0	0	4.8
Total staff costs	\$376,317	\$158,438	\$436,317	\$218,438	\$300,000
Drug costs	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000
Capital costs	\$ 20,000	\$ 20,000	0	0	0
Total costs	\$896,317	\$678,438	\$936,317	\$718,438	\$800,000

^a Clinical Pharmacist.

^b Nursing staff to accommodate increased intravenous admixture workload (1:1 nursing).

admixture services not provided by satellites in those hospitals.⁵

Several options for delivering integrated clinical-distributive pharmacy services (IV admixture, unit-dose system) to B.M.T. patients were presented in the following order of preference:

1. A satellite pharmacy located in or near the Oncology/B.M.T. Unit to service all beds (4-6 B.M.T. and 13-15 acute malignancy).
2. A satellite pharmacy located in or near the Oncology/B.M.T. Unit to service 4-6 B.M.T. beds only.
3. Provision of pharmacy services from the central pharmacy for all beds in the Oncology/B.M.T. Unit.
4. Provision of pharmacy services from the central pharmacy for B.M.T. beds only.
5. Maintain pharmacy services at the current level and have nurses assume responsibility for

drug inventory management, IV admixture preparation and other related functions for the B.M.T. beds.

Pharmacy services from the central pharmacy were considered unacceptable due to the distance between the two areas and potential delays in drug delivery. The central pharmacy is located on the ground level while the Oncology/B.M.T. Unit is located on the sixth floor of an adjacent building. In addition, pharmacy assistance with drug therapy management would not be readily available in the patient care area. The most desirable option was the provision of satellite pharmacy services for the entire unit. The basic assumption underlying this option was that acute malignancy patients require virtually the same pharmacy services as B.M.T. patients. The B.M.T. Planning Committee selected the second option, because the first option had staff cost implications above and

beyond that which could be justified for B.M.T. program funding (Table III). The pharmacy program was approved and funded to operate for limited hours of service (10-14 hours) per day.

Establishment of the Satellite

Space requirements for a B.M.T. satellite in the two resource hospitals were 400 and 750 square feet. With a working environment anticipated to be similar to that in existing H.S.C. satellite pharmacies, a physical space of 240 square feet was requested. Two sites on the Oncology/B.M.T. Unit were identified as potential locations for the satellite pharmacy. The preferred location was in the conference room approximately 10 feet from the nursing station. This central location would be convenient for nurses, and advantageous if satellite pharmacy services were expanded to include the remaining oncology beds. The alternate site was at the entrance to the unit, approximately 50 feet from the nursing station, in offices between two sets of air lock doors. This site was considered less desirable due to the decentralized location and need for frequent movement through the air lock doors. Since the existing office space was insufficient to accommodate the satellite pharmacy, additional space would need to be acquired from the adjacent patient lounge, resulting in renovation costs and a potential delay in satellite services. Despite being less desirable, space for pharmacy was granted in the latter location. The space was configured to provide a drug preparation/storage area, and office space.

Staff

Satellite staff levels were assigned at a total of three pharmacists, one half-time clinical pharmacist (added to an existing half-time po-

sition), and one half-time technician in the first three years of the program. The B.M.T. satellite is considered a separate functional area within the pharmacy department. Satellite pharmacy staff and drug distribution services are supervised by the senior pharmacist for oncology admixture services. This arrangement links two functionally related work areas (oncology admixture and B.M.T. services) and allows for additional staff resources for the satellite. Clinical services are co-ordinated by the clinical pharmacist for the Oncology/B.M.T. Unit. All pharmacists were recruited in May 1990 to allow for orientation, training and set-up of the new satellite pharmacy service. The pharmacy technician was recruited one month prior to the commencement of the new pharmacy services.

The three pharmacists work according to a master shift schedule, which provides for a six week rotation in the satellite pharmacy alternating with a three week rotation in the central pharmacy. The central pharmacy shift is equally divided between the Home T.P.N. program and satellite project time. Satellite staff vacation and sick time coverage is provided by the central pharmacy shift. The technician time is primarily allocated to T.P.N. preparation in the central pharmacy. Functions of the technician also include bulk IV admixture preparation and unit dose prepackaging for the B.M.T. satellite.

Operation of the Satellite

The B.M.T. satellite maintains service to an average complement of five adult or pediatric patients (range four to seven patients). Because the satellite is funded for B.M.T. patients, service is provided to them regardless of their pharmaceutical care needs relative to other Oncology Unit patients. Care of new B.M.T. patients is provided

from the beginning of their conditioning regimen and until their discharge from hospital. Bone marrow transplantation patients readmitted due to B.M.T. complications, and relapsed B.M.T. patients are the second and third priority for satellite pharmacy service respectively. When the pharmacy is not operating at full capacity with B.M.T. patients, services are provided to other Oncology Unit patients as mutually agreed upon by nurses and pharmacists. These patients tend to be acutely ill, and have complex IV or T.P.N. therapy needs, or require drugs for which significant clinical monitoring is needed.

The B.M.T. satellite pharmacy operates from 0800 - 1830 hours daily. These hours of operation eliminate the need for two overlapping shifts per day. In addition, the majority of physician's orders are written during this time. The Pediatric Intensive Care Unit (P.I.C.U.) satellite pharmacy was identified as a suitable night service (1830 - 0800 hours) location due to a direct pneumatic tube link and a night workload that could accommodate the limited number of orders originating from the B.M.T. Unit. To have a medication order filled during the night, the nurse must telephone the P.I.C.U. satellite pharmacy and send the order via pneumatic tube. The medication is then prepared and returned to the B.M.T. Unit by pneumatic tube. In the morning, the B.M.T. pharmacist retrieves the partly-filled original order and fills the remainder of the required doses.

The number of medication orders that are filled from 1830 - 0800 hours has decreased significantly from initiation of service to the present time. During the first four months of operation, the P.I.C.U. pharmacy filled an average of nine medication orders per month. In the last quarter of year one, the P.I.C.U. pharmacy filled

an average of only one medication order per month. Reduction of evening orders due to the loss of house staff from the B.M.T. Unit, and improved B.M.T. pharmacist anticipation of evening medication needs has contributed to decreased night service requirements.

The handling of medication orders is complicated due to the presence of two different drug distribution systems on one nursing unit. When a medication order is written, it is processed by the unit clerk or a nurse. If the patient receives B.M.T. pharmacy services, the order is directed to the B.M.T. pharmacist. Medication orders for non-service patients are sent by pneumatic tube to the central pharmacy, where they are processed by the central pharmacy dispensary (individual prescription/ward-stock). The B.M.T. pharmacy prepares selected medications for non-service patients according to the following criteria:

1. Medications that have historically been prepared by the sterile products area of central pharmacy. (e.g., amphotericin B)
2. Expensive medications that have a cost-saving potential if wastage can be reduced. (e.g., IV fluconazole, G-CSF)
3. Medications that are difficult or time-consuming for nurses to prepare. (e.g., antilymphocyte globulin, intravenous immune globulin)
4. Medication for a one-time dose, an initial dose, or an urgently needed dose, when requested by a nurse.

Total parenteral nutrition, chemotherapy, and narcotic orders are sent to and dispensed from the appropriate areas in the central pharmacy. A record of these orders is kept in the B.M.T. satellite patient profile for service patients only.

Intravenous admixtures are prepared in a laminar air flow hood

located in the B.M.T. satellite pharmacy. A syringe-based program is used. A 24-hour supply of medication is prepared daily. Dosage times are specifically arranged to ensure that the B.M.T. pharmacist is available to prepare the doses, and to ensure that drugs with limited stability are used shortly after preparation.

Certain intravenous medications are prepared in syringes to be administered by IVAC® syringe pumps. These include intermittent or continuous infusions of cyclosporine and continuous infusion potassium chloride concentrates. Many large volume parenteral medications are also prepared in the B.M.T. pharmacy. Intermittent or continuous infusion medications are prepared as needed during the day, and a quantity sufficient to last through the night is dispensed at the end of the B.M.T. pharmacist's shift.

All intravenous medications dispensed by the B.M.T. pharmacist are stored at the nursing station prior to administration. A small medication fridge contains a bin for each B.M.T. satellite full-service patient. Intravenous medications that must be maintained at room temperature are stored in the medication cassette. The medication cassette is a four-tiered box with four bins per tier. Each patient is assigned one tier within the cassette (three bins are for oral medications, one bin is for room temperature IV admixtures).

When the B.M.T. satellite pharmacy service was initiated, a 24 hour supply of parenteral "prn" medications was prepared in unit-dose syringes daily. To minimize wastage, parenteral "prn" doses are prepared now only when specifically requested by nurses. The balance of the "prn" medication doses are prepared by nurses from wardstock supplies, or vials provided in the unit dose bins.

Oral medications are packaged in moisture-proof, blister packages. Unit-of-use packaging is used whenever possible to decrease the number of blister packages that nurses must open. Oral liquid medications are dispensed in unit dose oral syringes or as multidose containers. Commonly used medications are prepackaged in large quantities. Less commonly used items are unit-dose packaged only as the need arises. All oral medications are dispensed for a 24 hour period. Scheduled doses required for dayshift nursing care are stored separately from scheduled medication for nightshift nursing care. Oral "prn" medications are also separated from scheduled medications.

Patients who are nearing the end of their hospital stay may be eligible for the medication self-administration program. This enables the patient or caregiver to prepare for medication administration at home while still under the supervision of the medical staff. The patient is counselled by a pharmacist regarding the medications and the appropriate medication schedule. The medications are dispensed by the B.M.T. pharmacy in a manner similar to an outpatient prescription. Prescription bottles are kept at the nursing station or in the patient's room. The nurse and pharmacist verify compliance through a medication self-administration chart completed by the patient. If necessary, drug packaging is altered to enhance compliance. Pass medications are also prepared by the B.M.T. satellite pharmacist.

Pharmaceutical Care

Prior to implementation of satellite services, pharmacists participated in a didactic course with emphasis on therapeutic management of cancer and B.M.T. patients. Teaching was provided by clinical staff of the pharmacy department. In

addition, the Oncology/B.M.T. clinical pharmacist provides ongoing one-to-one clinical teaching for the satellite pharmacist in drug therapy monitoring. Continuing education of B.M.T. satellite pharmacists is encouraged through participation in an Oncology/B.M.T. Journal Club. Pharmacists from the sterile products, oncology admixtures and T.P.N. admixture services join satellite pharmacists once monthly to review recent research in areas of specialty practice. Journals have been selected from the fields of adult and pediatric oncology/hematology and transplantation, as well as sterile product production, nutrition support and pharmacy practice.

Satellite pharmacists provide comprehensive pharmaceutical care for all service patients. Since a distinction between "clinical" and "distributive" pharmacy is not recognized, pharmacists use the full range of their skills to ensure that the desired therapeutic goals are achieved and that drug-induced illness is prevented. Pharmacists routinely consult with nurses and medical staff to select optimal therapeutic alternatives, develop therapeutic plans, evaluate the indication for and duration of therapy, modify drug dosage or administration method, detect problems for which drug therapy is indicated but has not been prescribed, and establish specific patient outcomes. The majority of consultations occur during drug deliveries to the ward. Attendance at rounds is limited to weekends and occasional weekdays, since the majority of rounding is devoted to non-service patients. Pharmaceutical care of non-service patients is provided by the clinical pharmacist but as nursing staff and medical staff have come to appreciate the pharmaceutical care role, satellite pharmacists handle an increasing number of therapeutic consulta-

tions for these patients. This occurs in particular during times that the clinical pharmacist is not available on the ward. The expertise of satellite pharmacists in the management of patients receiving T.P.N. therapy has been recognized by the oncology medical staff. Pharmacists monitor and alter electrolyte therapy for all Oncology Unit T.P.N. patients. Orders are reviewed and cosigned by a physician. Pharmacists participate in the weekly therapy review with Nutrition Support Team members. Therapeutic plans and interventions are documented on the T.P.N. monitoring flowsheet. Implementation of this process has greatly improved the efficiency and appropriateness of T.P.N. prescriptions.

Patient counselling is provided to all transplant patients and to other patients based upon need. Satellite pharmacists initiate medication self-administration programs, tailor medication schedules to the patient's home life, ensure completeness and correctness of the pocket medication card and arrange for the patient to obtain a medical emergency bracelet. Pharmacists are also responsible for counselling the patient concerning signs and symptoms of drug toxicity or therapeutic failure, who to contact in cases of emergency, and appropriate self-medication with nonprescription drugs (e.g., sunscreens, analgesics).

Continuity of pharmaceutical care is ensured by medication counselling after the patient is discharged from hospital. Pharmacists meet with the patient in the outpatient clinic to assess compliance and provide cyclosporine and prednisone dosage tapering instructions at Day 50 following transplantation. At Day 100, pharmacists reinforce correct dosage tapering, assess compliance and arrange for the availability of medications with the patient's com-

munity pharmacist. Satellite pharmacists also contact a hospital pharmacist in the patient's home town to ensure availability of medications to treat infectious and graft-related complications. Benefits of extended pharmaceutical care include prevention of emergency patient transport to Winnipeg, establishment of a pharmaceutical care network for transplant patients, and increased patient awareness of the pharmacist as a member of the health care team. Finally, outpatient follow-up permits satellite pharmacists to see the positive patient outcomes of B.M.T.

Program Acceptance

During the construction of the satellite, unit-dose/IV admixture pharmacy services were initiated and continued for six months from the central pharmacy. Initial acceptance of pharmacy services by nurses and physicians was hindered by the distant location of the central pharmacy. Medications were not always on the ward at the appropriate times due to poor communication between the pharmacist and nurse. The lack of standard IV medication administration times, and frequent changes of medication times to accommodate tests, radiation therapy and blood product administration created drug delivery problems on a daily basis. Since the pharmacist was accessible only by pager and travel time was significant, maintaining communication about medication changes was frustrating and time consuming for both nurses and pharmacists. In addition, acquisition of space from the patient lounge and the production of dust (with its attendant potential risk to immunocompromised patients) during the construction phase precipitated many negative comments.

The presence of two drug de-

livery systems on the same ward also resulted in problems. Drug doses were often drawn up by both the satellite pharmacist in the central pharmacy, and the nurse on the unit (from wardstock supplies). Orders for B.M.T. satellite service patients were occasionally sent to the central pharmacy dispensary rather than to the satellite pharmacists, resulting in duplicate filling of prescriptions. Pharmacists became frustrated by the lack of involvement in clinical activities, since the majority of their time was consumed by transport functions and resolving drug availability problems.

Finally, several drug packaging issues emerged. These issues are unrelated to the location of the pharmacy services, and continue to be unresolved. Specific issues addressed include: needles versus syringe caps on IV medications, difficult to open unit-dose blister packages, and lack of a satisfactory and economical method to provide unit-dose oral liquid doses of greater than 20 mL.

Frustrating drug delivery problems resolved almost immediately upon completion of satellite construction, and a subsequent move (from central pharmacy to the Oncology Unit). Technical problems such as dose administration time changes and duplicate preparation of drug doses were less common due to better nurse-pharmacist communication. Pharmacists were more visible, and available to answer questions concerning IV drug compatibility, adverse drug reactions, drug administration, and appropriateness of therapy. Decreased time spent with drug transport and drug distribution problems permitted increased time for therapeutic drug monitoring and proactive pharmaceutical care. Nurses, physicians and other health care professionals have come to rely upon the immediacy of drug

and information provision by satellite pharmacists.

In conclusion, after 15 months of operation, the B.M.T. satellite pharmacy has provided service for 2193 patient days, of which 1088 days have been B.M.T. patient days. Twenty transplants have been performed to the end of February 1992. Ongoing problems due to unit dose packaging and the existence of two drug distribution systems on one ward are being addressed. B.M.T. satellite pharmacy patient care services are well accepted and will continue to evolve as new pharmaceutical care opportunities are identified. ☒

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