

Home intravenous self-injection of antibiotic therapy

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AY MARTEL. Home intravenous self-injection of antibiotic therapy. Can J Infect Dis 1994;5(Suppl C):51C-55C. The current medical climate has forced all health care providers to search for alternative methods for the delivery of health care. This search has led to the use of sites outside the conventional hospital walls for peritoneal dialysis, parenteral hyperalimentation, blood or blood product transfusions, etc. Home intravenous self-injection of antibiotics is such an alternative to prolonged and/or repeated hospitalization for patients requiring intravenous antibiotics administration only. This alternative was started as a pilot study and soon became a usual service in the Centre hospitalier de l'Université Laval following receipt of a grant from the National Health Research and Development Program. After careful development of inclusion/exclusion criteria and a teaching manual for patient and health care providers, and the standardization of medical, pharmaceutical and nursing approach, a clinical, psychosocial and economical analysis of patients who agreed to participate in a clinical study comparing the two methods of health care delivery (hospital versus home) was started. Patients who met inclusion/exclusion criteria, agreeing to finish their treatment at home instead of staying hospitalized to receive intravenous antibiotics only, were taught the various techniques of intravenous self-injection. Once they were judged to be able to self-administer the antibiotics, they were sent home with the material needed to carry on their treatment. To date, more than 100 patients have participated in the home-treatment, of which 50 were analyzed. The duration of home treatment varied from two days to several months. Most patients had osteomyelitis, septic arthritis, septic bursitis, bacterial cellulitis or lung infections. The therapy allowed some newly defined patients with complicated infections (AIDS patients with cytomegalovirus retinitis) to continue their treatment at home. The clinical outcome of patients treated at home was identical to the outcomes of those treated in the hospital. Side effects were comparable with the hospital treatment and were mainly catheter-related. Compared with hospitalization, home treatment was preferred by the majority of patients. Psychological analysis of the patients showed that those who choose home therapy had a higher internal 'locus of control' than those who preferred to stay in the hospital for the entire length of therapy. The economical analysis showed a potential reduction of cost varying between \$941.00 and \$3325.00 per treatment. Home intravenous self-injection of antibiotics allowed health self-monitoring by the patients or/and their friends or family and increased health care efficiency.

Key Words: *Antibiotic therapy, Home intravenous self-injection*

Antibiothérapie intraveineuse à domicile

RÉSUMÉ : Les restrictions budgétaires actuellement ressenties dans le domaine de la santé ont forcé tous les intervenants à rechercher des alternatives à la dispensation actuelle des soins. Cette recherche a conduit à l'utilisation de lieux de traitement situés hors des murs hospitaliers actuels pour la dialyse péritonéale, l'hyperalimentation parentérale, les transfusions de sang et de dérivés du sang, etc. L'autoadministration d'antibiotiques par voie intraveineuse à domicile est une alternative à l'hospitalisation prolongée et/ou

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répétée de bénéficiaires qui ne requièrent qu'une administration d'antibiotiques par les veines. Cette alternative à l'hospitalisation a débuté par un projet-pilote et s'est inséré, par la suite, dans un contexte de dispensation normale des soins dans le Centre hospitalier de l'Université Laval au moment de l'obtention d'une subvention du Programme National de Recherche et de Développement en Santé. Après l'élaboration soignée de critères d'inclusion, le développement d'un manuel d'enseignement aux bénéficiaires et aux intervenants et l'uniformisation de l'approche des médecins, des pharmaciens et des infirmières, nous avons débuté une analyse clinique, psychosociale et économique des sujets qui participaient au traitement à domicile en les comparant à une clientèle qui préférerait poursuivre leur traitement à l'hôpital. Les sujets qui répondaient aux critères d'inclusion et qui demeuraient hospitalisés pour recevoir une antibiothérapie intraveineuse, étaient instruits des techniques d'administration intraveineuse. Après avoir démontré leur capacité à s'auto-injecter les antibiotiques, ils étaient libérés de l'hôpital avec le matériel nécessaire à poursuivre leur traitement. Jusqu'à maintenant, plus d'une centaine de sujets ont participé au traitement. La durée du traitement à domicile des sujets a varié entre deux jours et plusieurs mois. La plupart des sujets présentaient une ostéomyélite, une arthrite septique, une bursite septique, une cellulite bactérienne ou une surinfection bronchique. Cette alternative a aussi permis à certains sujets atteints d'autres infections compliquées, ex: sidéens avec rétinite à Cytomégalovirus, de poursuivre leur traitement à domicile. L'évolution clinique des sujets à domicile comparée aux sujets hospitalisés était comparable. Les effets secondaires n'étaient pas plus fréquents qu'à l'hôpital et le traitement à domicile était préféré au traitement hospitalier dans la majorité des cas. L'analyse psychologique des sujets a démontré qu'ils avaient un «locus de contrôle» interne plus significativement élevé que ceux qui préféraient demeurer hospitalisés. L'analyse économique a démontré une économie potentielle pouvant varier entre \$941.00 et \$3 325.00 par traitement. L'autoadministration intraveineuse d'antibiotique à domicile permet l'autogestion de la santé par le bénéficiaire et/ou son entourage et augmente l'efficacité du système actuel de soins.

THE NATIONAL HEALTH CARE SYSTEM IS TAKING NEW DIRECTIONS: patient self-sufficiency and costs are now considered with quality of care. Patients with chronic illnesses often require prolonged or repeated hospitalizations. To shorten hospital stay, programs such as home hemodialysis (1-3) and peritoneal dialysis (4-6), parenteral hyperalimentation (7-9) and home transfusions (10,11) are already offered to patients. These programs are considered to be hospital alternatives and their implementation is strongly encouraged. They are felt to increase health care system access by freeing up hospital beds. They contribute directly to clear up emergency room beds by treating patients at home when their illness is stabilized.

Home intravenous self-injection of antibiotics is part of this innovative perspective (12-20). It helps patients to be self-sufficient in their own care. Advantages for the patient are numerous. Home intravenous self-injection of antibiotics helps the patient to carry on treatment at home after a shorter hospital stay; it allows a more rapidly recovered autonomy; it improves quality of life by allowing more rapid resumption of familial and social life; and finally, it lowers hospital-related emotional and physical burden.

This paper summarizes the results of a pilot study and a prospective study done at Le Centre Hospitalier de l'Université Laval between 1984 and 1991 (21,22).

PATIENTS AND METHODS

From January 1984 to May 1989, home intravenous self-injection of antibiotics was a case service offered to patients who wanted to go home while in hospital for intravenous antibiotics (23). To implement the service, all parties involved were identified. An infectious diseases consultant, a pharmacist, a department nurse, an out-patient nurse and an administrator

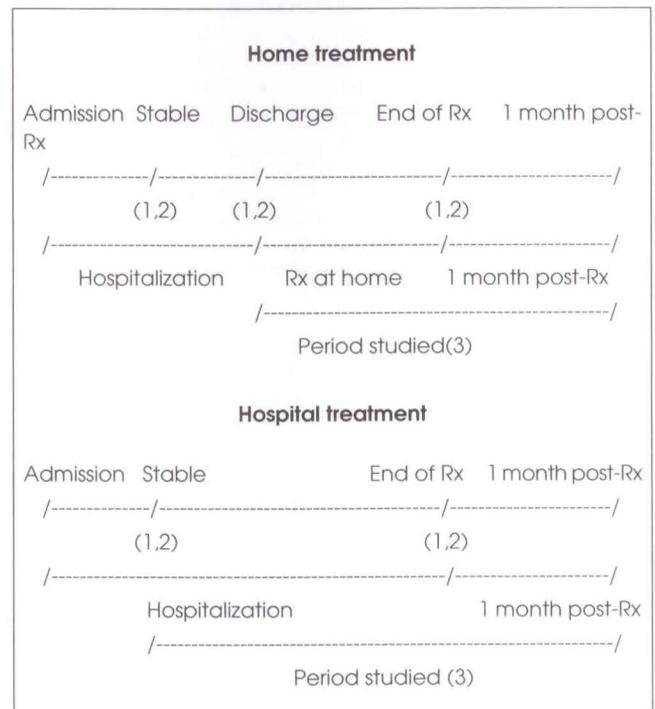


Figure 1) Time lines for in-hospital and home antibiotic therapy, comparing safety and efficacy of each treatment alternative. 1 Clinical evaluation; 2 Psychosocial evaluation; 3 Economical evaluation; Rx treatment

formed a committee whose task was to define admission criteria, develop procedures to be followed by the patient and other parties, and standardize teaching procedures to patients as well as the ways to prepare and deliver antibiotics.

Admission criteria were: age (range 18 to 65 years); treatment of the infection with intravenous antibiotics only (no oral alternatives, no other treatments while on intravenous antibiotics); clinical stability, with lack of

TABLE 1
Pathologies treated with home intravenous antibiotics

Pathology	Patients treated
Osteomyelitis	56
Septic arthritis	12
Septic bursitis	7
Cellulitis	8
Cystic fibrosis with bronchial surinfection	9
AIDS patients	
Cytomegalovirus retinitis	5
Cryptococcosis	2
Disseminated <i>Mycobacterium avium</i> complex infection	1
Cerebral toxoplasmosis	2
Syphilis	1
Complicated urinary tract infection	2
Severe external otitis	3
Chronic sinusitis	3
Cutaneous blastomycosis	1
Endocarditis	2
Lung abscess	1
Liver abscess	1

complication due to infection or treatment; and easy intravenous access.

At the beginning, the program was introduced to patients who wanted to go home. Later, patients who preferred to stay hospitalized were also included in the prospective analysis. The analysis included clinical outcome and sociopsychological and economical aspects of the two alternatives. From the time the patient's condition was judged stable until one month post-treatment, patients were followed by the main investigator through weekly clinical exams completed with once-weekly blood samples for various biological determinants to assess clinical evolution. Safety and efficacy of the two alternatives were compared (Figure 1).

Sociopsychological evaluation proceeded through the administration of questionnaires to determine the patient's phobia avoidance, health locus of control (24), opinions on illness and antibiotic therapy and the presence of psychopathological disorders that would compromise the course of the program (major depression, severe anxiety, intravenous drug abuse). Questionnaires included the Beck depression inventory (25) and the Spielberg anxiety scale (26), which were followed by a diagnostic interview with a psychologist. All were performed at different times throughout the course of antibiotic treatment (Figure 1).

The economical analysis proceeded through identification of resources used during treatment, identification of their unit cost by stepdown costing (27) (better than per diem) and the calculation of the real cost of treatment (Figure 1).

The patient's training program lasted from three to five days and was presented by the doctors. Nurses and pharmacists tried to standardize participant interven-

TABLE 2
Pathogens isolated

Gram-positive cocci: <i>Staphylococcus aureus</i> , <i>Staphylococcus epidermidis</i> , <i>Staphylococcus warneri</i> , Group A beta-hemolytic streptococcus, Group B beta-hemolytic streptococcus, <i>Streptococcus viridans</i>
Gram-positive bacilli: <i>Bacillus</i> species
Gram-negative cocci: <i>Neisseria</i> species
Gram-negative bacilli: <i>Pseudomonas aeruginosa</i> , <i>Xanthomonas maltophilia</i> , <i>Serratia marcescens</i> , <i>Escherichia coli</i>
Anaerobes: <i>Fusobacterium</i> species, <i>Bacteroides fragilis</i> , <i>Streptococcus anaerobius</i>
<i>Mycobacterium avium intracellulare</i>
Parasites: <i>Toxoplasma gondii</i>
Yeast: <i>Blastomyces dermatitidis</i> , <i>Cryptococcus neoformans</i>
Virus: Cytomegalovirus

tions, to familiarize patients with infusion material, antibiotics, solutions, to demonstrate methods to the patients' families and to check for the appropriate execution of the techniques by the patient after proper evaluation of patients' skills. Nurses and pharmacists were also referred to as a backup for patients at home as in- or out-of-hospital contacts.

RESULTS

More than 116 patients participated in the treatment at home. Of these, 33 were evaluated prospectively and compared with 17 patients who preferred to carry on their treatment in the hospital. There were 28 females and 88 males. Mean age was 41 years in females (range 16 to 60) and 36 years in males (range 16 to 62). Almost half had osteomyelitis; pathologies are outlined in Table 1.

The pathogens most frequently isolated reflected those most often involved in such infectious diseases (Table 2). Gram-positive cocci, mainly *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Streptococcus* species were the most frequently isolated pathogens, followed by Gram-negative bacilli such as *Pseudomonas aeruginosa*, *Xanthomonas maltophilia*, *Escherichia coli* and *Serratia marcescens*, and anaerobes such as *Bacteroides fragilis*, *Fusobacterium* species and *Streptococcus anaerobius*.

Antibiotic therapies most often used are shown in Table 3. Most of them included a cephalosporin such as cefazolin, ceftriaxone or ceftazidime. Also frequently used antibiotics were aminoglycosides, clindamycin, gancyclovir and amphotericin B.

Peripheral venous access was used whenever possible and central venous catheters such as Port-A-Cath

TABLE 3
Antibiotics used during treatment at home

Penicillins: penicillin G, cloxacillin
Cephalosporins: cephalothin, cefazolin, cefoxitin, cefotaxime, cefoperazone, ceftriaxone, ceftazidime
Aminoglycosides: gentamicin, netilmicin, tobramycin, amikacin
Clindamycin
Erythromycin
Gancyclovir
Amphotericin B

(Pharmacia), Broviac (Bard) catheters or simply a sub-clavian vein catheter were used when peripheral vein access was impossible.

Complications related to the home intravenous treatment were as frequent as in the hospital and included headache, severe reversible neutropenia, generalized maculopapular rash, nausea, diarrhea, pseudo-membranous colitis, loss of appetite and weight loss, tinea cruris, vaginal discharge and transient elevation of liver enzymes. Complications related to the intravenous lines included local infiltrations, edema, redness and pain at insertion sites and thrombosis, pneumothorax, local hematoma and, for the long-lasting catheters, local and systemic infections. These complications were not more frequent in hospital than in home treatment and were not more serious in either alternative.

Preliminary results of the prospective analysis have shown that the clinical outcomes of the patients treated in hospital versus home were the same (two patients treated with home treatment were readmitted for a major side effect and a treatment failure and one patient with hospital treatment was readmitted for treatment failure). All the clinical and laboratory follow-up exams were comparable between the two treatment groups. The psychosocial analysis showed a significantly different locus of control between the two groups: those who wanted to go home had a significantly higher internal locus of control while the hospital group had a significantly higher external locus of control. The main reasons for accepting the home treatment option were sociofamilial (which was termed a higher quality of life), wanting to carry on normal activities and to have a higher autonomy or liberty. The hospital group had a low confidence in their own efficacy. If patients who went home were asked if they would use home treatment again, 89% answered affirmatively if the cost of antibiotics were to be payed by a third party. Thirty-two per cent agreed to participate again even if they were to be responsible for the cost of antibiotics. The economical analysis showed a mean cost of \$3852.00 (range \$2085.00 to \$7794.00) for patients treated at home compared with \$5493.00 (range \$1490.00 to \$8725.00)

for patients treated in the hospital. The differences between the alternatives were accounted for by nursing time, professional fees and hostelry. All scored significantly higher in the hospital group.

DISCUSSION

Intravenous antibiotic therapy can be delivered to out-patients in several ways. Self-injection is probably the most efficient way to deliver intravenous antibiotics, as long as there is a careful selection of patients who participate in such treatment and adequate nursing support. Patients who prefer to be treated at home had a statistically higher internal locus of control than patients who stayed in hospital. They preferred home treatment because this alternative gave them the opportunity to keep a higher quality of life, a normal familial life and a greater autonomy. They could carry on normal activities while under treatment. Those who decided to stay in hospital had a higher external locus of control, less confidence in their own efficacy to deal with their health problem and did not see advantages to carrying on their treatment at home. The majority of patients treated at home preferred this option to hospital and would do it again in a proportion of 89%. If the patients had to pay for the cost of the antibiotics, this preference would be lowered to 32.4%. Other major pitfalls related to home treatment were related to transportation to the out-patient clinic for follow-up visits and the infusion schedule.

In agreement with previous studies, we found no statistical difference in the clinical outcomes between patients treated at home and those treated in hospital. Some pathologies seemed to best fit such a program due to the length of treatment, ie, osteomyelitis, cytomegalovirus retinitis, and/or the recurrence of the infections (bronchial superinfections in cystic fibrosis patients). The choice of antibiotics must be guided by several pharmacokinetic characteristics. Antimicrobial spectrum, tissue penetration, half-life at room temperature once diluted as well as half-life once infused, and compatibility with other antibiotics in the same infusion bag are the most important points to consider. Anatomical sites for intravenous line insertion and peripheral versus central lines must also be identified before the patient is sent home.

We observed a trend towards lower costs for home treatment versus hospital treatment although there was large overlap between the two alternatives. The cost in personnel and lodging accounted for about 80% of the cost in hospital. Are these savings going to decrease the cost of health care? This question remains partly unanswered since the health care budget is scrutinized by different sectors. Compared with the cost of the actual treatment of hospitalized patients, home self-injection of antibiotic treatment is economical. But, from an administrative viewpoint, offering the home therapy alternative is not economical because the beds are freed for more

urgent or sicker patients, whose care will be more expensive than the antibiotic therapy. Furthermore, if the hospital has to pay for the cost of antibiotics, the cost to the hospital administration will be higher because the bed will be occupied by another patient and, at the same time, the hospital will have to pay for the intravenous antibiotic therapy for the patient discharged home.

In the context of closed budget and reduced expenses, it seems to be very difficult for Canadian health care advisers to make the right decisions without

threatening some of the basic principles of free quality health care that has guided this society. Making available alternatives such as this one for out-patient treatment is one answer to the increasing concern with health care costs. People are more aware of their capacity for self-treatment as long as we provide them with an adequate supervision to make them confident of their own capacities. This kind of treatment is likely the beginning of several other alternatives for out-patient treatment.

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