Home intravenous antibiotic therapy[1]

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Physician awareness of the feasibility of outpatient therapy has increased in response to the recent emphasis on medical cost containment. As a result, both health care institutions and commercial concerns are working rapidly to provide supplies and services for patients receiving therapy, such as intravenous antibiotic therapy, at home.

Index term: Home care services

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Few ambulatory care programs have expanded as rapidly as those providing intravenous (IV) antibiotic therapy in the home. Such treatment is given to patients requiring prolonged antibiotic administration for a variety of serious infections. In contrast to other home regimens, which are often designed for permanently disabled patients, it is limited to a few days or weeks. Like programs for home parenteral nutrition and home dialysis, home antibiotic therapy evolved because of patients' requests for an earlier discharge from the hospital. The resulting improved quality of life and potential for return to normal activities make outpatient care an attractive option in spite of the burdens imposed on both patient and family. Moreover, the introduction of prospective reimbursement systems in the past year has provided new incentives to shorten the hospital stay.

Historical perspective

Rucker and Harrison offered the first report of success-

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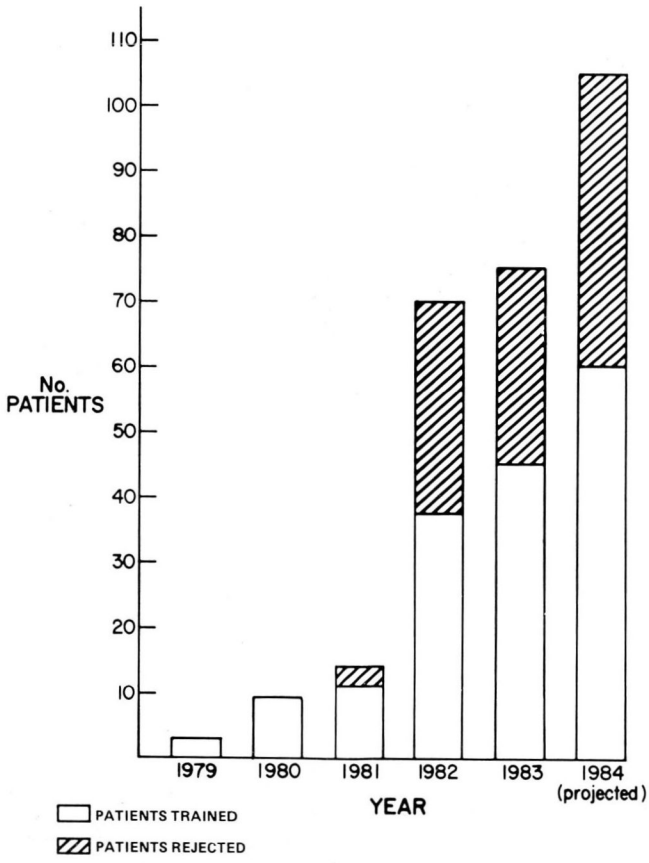

Fig. 1. Graph showing the number of patients trained for the Cleveland Clinic home IV antibiotic therapy program and the number of patients rejected between April 1979 and July 1984.

ful self-administration of parenteral antibiotics in 1974.[1] They treated a number of young cystic fibrosis patients who had acute exacerbations of pulmonary infection and noted no unusual complications associated with home therapy. Four years later, Antoniskis et al compared inpatient versus outpatient IV antibiotic therapy in a small number of cases and found that the incidence of adverse reactions and therapeutic failures appeared to be similar in both groups.[2] Stiver et al have had extensive experience with administration of IV antibiotics at home.[3,4] Their program differed from those summarized earlier in that nurses delivered antibiotics to the patients' homes and changed the heparin locks during these visits. Another option for venous access is the peripherally inserted central catheter, which has been used frequently by Kind et al.[5] In 1982, Poretz et al reported on the results of home IV antibiotic therapy in 150 patients.[6] Antibiotic-associated adverse effects were mild and infrequent; overall, more than 90% of treatments were successful. Based on these data, it is clear that the administration of antibiotics at home is not only feasible but in many cases desirable. Patients receiving extended therapy are subject to frustration and boredom during hospital stays. The financial burden of prolonged hospitalization is great not only in terms of the direct cost of inpatient care but also because of lost wages. Thus further development of home programs has been stimulated by medical, social, and economic issues.

Cleveland Clinic program

Since 1979, selected patients at the Cleveland Clinic have been trained to self-administer parenteral antibiotics. Because of procedural problems, a multidisciplinary team was organized in November 1981 to coordinate patient evaluation, training, and follow-up care. Details of this process have been reviewed.[7] Patients selected as candidates for home IV antibiotic therapy by their physicians or nurses are interviewed by the Infectious Disease Clinic nurse, a social worker, and a physician specializing in infectious diseases. If it is determined that the patient is qualified in terms of medical and psychosocial stability, arrangements are made for reimbursement for outpatient therapy. Accepted patients enter an intensive training program and are taught to administer antibiotics they have tolerated in the hospital. They must demonstrate proficiency in all phases of their treatment prior to discharge. Each patient receives a set of written instructions and a list of the team members' telephone numbers. Both nurses and physicians are available by phone at all times. Pre-mixed antibiotics are supplied in refrigerated or frozen form in plastic minibags.[8,9] A few patients are instructed in the reconstitution of their antibiotic beginning with dry powder. If the patient will be mixing his or her antibiotic at home, he or she receives an average of three hour-long training sessions with the team pharmacist.

The IV therapy nurse provides instruction in heparin lock care and administration of the antibiotic following the pre-arranged schedule. The nurse also reviews criteria for heparin lock replacement as well as potential complications[10–14] and shows the patient the outpatient IV therapy area. The standards of the National Intravenous

Therapy Association for home IV therapy are used in patient training.[15] Patients requiring a Hickman or Broviac catheter[16] receive instruction in catheter care and antibiotic infusion from the total parenteral therapy team nurse.[17] Usually three training sessions are required. Follow-up visits with a physician (either locally or at the Cleveland Clinic) take place every three to 10 days during the course of outpatient therapy and are arranged before the patient is discharged. The frequency of return visits and laboratory evaluation is determined by the patient's condition and the type of antibiotic employed. Patients who live in the immediate area return to the outpatient IV therapy department every 72 hours for heparin lock replacement. Round-the-clock nursing support is provided in case of difficulty with IV access. Some patients are managed by home care nurses under the supervision of a physician, allowing those with limited mobility to remain in the home. Physical assessment, IV access care/replacement, blood sampling, and reinforcement of technique may take place during these visits. All patients return to their primary physician at the Cleveland Clinic at least once after the course of therapy is prescribed. Questionnaires are distributed to obtain information about the training program, third-party reimbursement, and long-term effects of therapy. Records of patient evaluations and outcome are kept in the Infectious Disease Department.

Results

Between April 1979 and July 1984, 223 patients were referred to the home IV antibiotic therapy team for evaluation (*Fig. 1*). Of these, 89 patients (40%) did not undergo training because they were not optimal candidates for home therapy. Medical considerations, including unstable physical status, the need for complex treatments, poor mobility, and lack of manual dexterity, accounted for nearly one-half of the cancellations. If IV antibiotic therapy was considered unnecessary, or if the length of IV therapy remaining was very short, the cancellation was also classified as "medical." On occasion, patients trained in the hospital exhibited medical complications related to their illness or antibiotic therapy prior to discharge, necessitating continued inpatient care. Thirty patients did not undergo training because of psychosocial issues. A history of substance abuse, poor compliance, or inability to cope was discovered during evaluation in many cases; other patients lacked adequate home support to complete outpatient therapy. Training of an additional 16 patients was cancelled for financial reasons; the average age of this group (53) was somewhat higher than that of the patients rejected for medical and psychosocial problems (47) (*Table 1*).

Table 1. Ages of patients considered for the Cleveland Clinic home IV antibiotic therapy program

Year	Patients trained (Average age in yr)	Patients cancelled (Average age in yr)	All patients (Age range in yr)
1979	31	. . .	17–44
1980	31	. . .	23–39
1981	43	50	22–63
1982	41	48	10–77
1983	43	48	12–71
1984*	42	56	24–86

* Jan 1–July 1

Most of the 134 patients who underwent training for home IV antibiotic therapy had bone and joint infections, but a variety of other severe infections were also treated at home (*Table 2*). Device-associated conditions, such as infected total joint prostheses, indwelling IV catheters, and chronic ambulatory peritoneal dialysis catheters, accounted for nearly one fourth of diagnoses. *Staphylococcus* was the most common pathogen isolated from the infected site. One third of patients required a Hickman or Broviac catheter for venous access, while two thirds used heparin locks. Three were readmitted for central venous catheter placement because of inability to main-

Table 2. Infections treated at home (Apr 1979–July 1984)(N = 134)

Diagnosis	No. of patients
Osteomyelitis	43 (31.9%)
Device-associated infection	33 (24.4%)
Deep abscess/wound infection	21 (15.6%)
Septic arthritis/bursitis	10 (7.4%)
Endocarditis	9 (6.7%)
"Diabetic foot"	6 (4.4%)
Miscellaneous	13 (9.6%)
TOTAL	135*

* One patient was treated for two different infections.

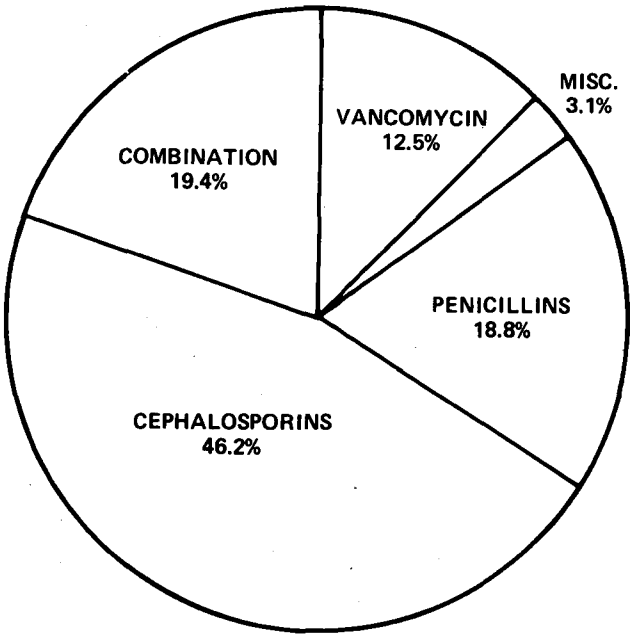

Fig. 2. Antibiotics employed for home IV therapy at the Cleveland Clinic between April 1979 and July 1984.

tain access via heparin locks. Cefazolin was the antibiotic most frequently prescribed (*Fig. 2.*). On the average, patients were hospitalized for three weeks, with outpatient therapy continuing for 24 days. When the costs of antibiotics, intravenous supplies, laboratory monitoring, and physician's fees are taken into account, the daily savings were approximately the same as the fee per day for a semi-private hospital room.

Adverse effects related to antibiotics were observed in 25 out of 160 courses of therapy (15.6%). None were life-threatening, but readmission for evaluation of fever was required in three instances. Skin rash was the most frequent adverse effect and required discontinuation or alteration of therapy in many cases. Significant diarrhea complicated therapy in two cases, but antibiotic-associated colitis was not observed.

Table 3. Patients receiving more than one course of therapy (Apr 1979–Sep 1984)

Diagnosis	No. of patients
Osteomyelitis	
Trauma-related	6
Diabetes	3
Neoplasm	3
Sternal	2
Prosthetic joint	2
Other	2
Abscess and neoplasm	2
Endocarditis	1
Infected CAPD catheter	1
Two different infections	2
TOTAL	24

Twenty-four patients have received more than one course of therapy at home (*Table 3*). As might be expected, most patients who receive multiple courses have some form of complicated osteomyelitis or underlying systemic illness such as diabetes mellitus, lupus erythematosus, or cancer. Multiple hospital admissions were common, and 16 of the 18 patients readmitted with osteomyelitis underwent some form of surgery between antibiotic treatments. Four patients required amputation for cure. Thus far, 2 patients have been readmitted for non-medical reasons. One patient, a woman with teenage children, found that she had difficulty coping with the home IV antibiotic therapy regimen. The other patient was a young man whose housing situation would not accommodate continuation of IV antibiotics.

Comparison of programs

Published reports of home IV antibiotic therapy programs are similar in terms of patient ages, diagnoses, and duration of treatment (*Table 4*). While data are incomplete, in most series a small percentage of patients required readmission to the hospital for reasons categorized as psychosocial (poor compliance, inability to cope) or medical (persistent infection, antibiotic-related adverse effect, loss of IV access). Many of the patients requiring admission for incompletely controlled infections had osteomyelitis or related conditions; in this series, almost 90% of patients readmitted for osteomyelitis underwent surgery. Patients often required further antibiotic therapy postoperatively. There seems to be no evidence that home therapy caused relapse of infection or adverse reactions.

Future issues and concerns

Newer treatment regimens for various infections may change the nature of home parenteral antibiotic therapy programs. It appears that some cases of osteomyelitis in children can be successfully treated using a short course of IV therapy followed by long-term oral antibiotics.[18–22] Similarly, experience at the Mayo Clinic indicates that selected patients with streptococcal endocarditis

Table 4. Home IV antibiotic therapy: comparison of programs

Authors	No. of Patients	Age Range (yr)	Diagnosis	No. of courses of antibiotic therapy	Duration of therapy (days)	Comments
Rucker and Harrison[1]	52	7–27	Cystic fibrosis	127	10–12	40 patients required hospitalization for more aggressive therapy
Antoniskis et al[2]	13	12–61	Osteomyelitis, endocarditis, bacteremia	13	21	3 patients required readmission due to poor IV access in 2 and emotional problems in 1
Stiver et al[3,4]	95	4–81	Osteomyelitis, septic arthritis, endocarditis, cystic fibrosis	102	23	10 courses failed: 6 patients had chronic osteomyelitis, 2 cystic fibrosis, 1 endocarditis, and 1 *Candida* pyelonephritis
Kind et al[5]	15	3–61	Osteomyelitis, septic arthritis, endocarditis	15	17	No rehospitalizations, 12–36 mo follow-up
Poretz et al[6]	150	3–86	Osteomyelitis, septic arthritis, pyelonephritis, wound infection	150	20	10 patients required brief readmission for surgery
Rehm and Weinstein[7]	48	10–77	Osteomyelitis, septic arthritis, abscess/deep wound infection, endocarditis	56	19	6 patients required further therapy involving surgery in four cases

may be safely treated for only two weeks.[23] If further investigation can prove that shorter courses of IV antibiotic therapy are efficacious, a significant saving may be realized.[24]

Advances in antibiotic pharmacokinetics will also be an important factor in home therapy. Newer cephalosporins, such as cefonicid and ceftriaxone, have a prolonged half-life, allowing them to be given once or twice a day. Less frequent administration of antibiotics should improve patient compliance and decrease the cost of antibiotics and supplies.[25,26] Animal studies by Perry et al indicate that local antibiotic infusion may be effective in the treatment of osteomyelitis.[27]

A number of growing concerns in institutions offering home programs relate to the provision of both supplies and nursing services after the patient is discharged. Many large hospitals and health maintenance organizations have organized an "in-house" system, while others rely upon external suppliers or home care agencies.[28,29] Careful supervision of the venous access site, laboratory work, and clinical status may be accomplished either in the clinic or at home, depending upon the patient's condition, the complexity of the therapy, and the availability of care givers.

Third-party reimbursement for home IV antibiotic therapy is extremely variable, and generalizations about private insurance are impossible because of the differences in individual policies. When insurance policies are screened prior to initiation of home therapy, approximately 80% of the billed charges are reimbursed; however, payment is usually delayed because additional correspondence and justification of therapy are required in many cases. Unfortunately, Medicare does not offer any reimbursement for parenteral antibiotic therapy at home,[30] which may have far-reaching implications since the elderly represent a rapidly expanding segment of the population. It is hoped that further documentation of the safety and efficacy of such programs may be useful in effecting policy changes.

Obviously, careful evaluation and selection of patients for home IV antibiotic therapy is essential, as abuses might result in unnecessary costs and adverse effects. In addition, reimbursement could be restrained further if home therapy is perceived as a non-essential "add-on" cost rather than as an alternative to expensive inpatient care.[31] The development of stringent criteria for therapy of chronic osteomyelitis would be particularly useful in view of the high rate of readmis-

sion, surgical procedures, and multiple courses of therapy in these patients.

Conclusion

Home IV antibiotic therapy programs were instituted because patients requested earlier discharge from the hospital. Further interest was generated by efforts to decrease hospital costs. Success depends on careful patient selection, training, and follow-up. Evaluation of the patient must address three central issues: (*a*) medical stability, (*b*) need for IV antibiotic therapy, and (*c*) the likelihood of cure of infection with antibiotics. Candidates must be well-motivated and compliant and have access to competent medical personnel while at home. Cost savings, in terms of both hospital charges and lost wages, can frequently be realized when appropriate patients are discharged from the hospital earlier and return to a more normal life style.

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