We have witnessed major shifts in the delivery of health care from the hospital to community settings during the past decades, in part, due to technological improvements, medical cultural changes, cost-containment efforts and patient preferences. Central to this changing environment has been the development of outpatient parenteral antimicrobial therapy (OPAT) clinics and services. A wide range of OPAT treatment models have been adopted in many jurisdictions worldwide, and these have been shown to be safe and highly cost-saving compared with inpatient management (1-10). In many regions, OPAT has become a significant part of the job description of adult infectious diseases specialists. Extensive reviews of OPAT program development and requirements have been published (11-13). In the present note, we briefly review the development, potential benefits and challenges associated with OPAT, and focus on contemporary issues relevant to adult infectious diseases specialists.

HISTORY
OPAT traces its origins to the 1970s (12,14,15). In 1978, Stiver et al (15) published one of the first reports on the use of OPAT. The study involved 23 patients who were admitted to hospital with chronic infections in Winnipeg (Manitoba) and were subsequently discharged and successfully completed intravenous antimicrobial therapy as outpatients. During the 1980s and 1990s, an increasing number of reports were published, which principally described OPAT program development and documented its safety and cost effectiveness. Early OPAT programs were focused on facilitating the discharge of stable inpatients with infections who, other than the requirement for prolonged intravenous antibiotic therapy, had no other need for inpatient care. During the past two decades, there have been an increasing number of descriptions of OPAT programs that have attempted to avoid hospitalization altogether for many patients with acute infections (9,10,12,16,17).

DELIVERY MODELS
There has been a wide range of program descriptions published worldwide for the provision of OPAT (6,12). Two key considerations in program delivery include the method(s) by which the antimicrobial is administered and how patients are monitored during therapy. The main administration models presently being used may be classified as infusion clinics/centres, provider-based in-home health care and self-administration.

Patients travel to ambulatory infusion centres on a regular basis to receive their treatments (4,18). These infusion centres may be housed within the day-care areas of hospitals or be freestanding clinics or physician offices in the community. In some cases, the emergency department may be used for this purpose. The infusion centre model has major advantages for the efficient delivery of care, including keeping staff and services within one location and having the ability to treat numerous patients simultaneously. In addition, monitoring is facilitated because patients are regularly assessed. However, if typical business hours are observed, one potential drawback is the inability to provide dosing of drugs more than once per day. Furthermore, the requirement for patient travel to the clinic may be inconvenient, expensive and exclude patients with limited mobility.

Inhome provider models require trained health care providers to attend to patients in their personal domiciles for infusions. Typically, patients are first assessed in a hospital or at an ambulatory care clinic before prescription, although this may be achieved entirely using home visits initiated by physician house calls (19). The primary advantages of inhome delivery models are that patients are regularly monitored and that patient travel is minimized. However, the principal drawbacks are related to inefficiencies in delivery that arise from the requirement for health care workers to regularly travel to patients’ homes. This is particularly relevant in geographically dispersed areas or in cases for which multiple daily dosages are required. In addition, issues of health care provider safety may present a concern.

Patients may self-administer infusions using gravity, syringes, elastomeric infusion systems or mechanical infusion pumps. With the first three methods, patients will need to connect the supply of drug and its associated tubing to their pre-existing intravenous access for each individual infusion and disconnect them after each dose. With mechanical infusion pumps, a programmed pump may be used to administer doses (5). This is particularly useful when multiple daily doses are prescribed because the drug can be infused at programmed intervals and patients only have to change the supply of drug once per day (18,20). Both elastomeric infusion systems and infusion pumps may be used for continuous slow infusions.

The key advantage of the self-administration models are patient convenience because they can set their own schedule and are not required to stay in their own home to perform the infusion. The disadvantages are potentially numerous and include the fact that patients must possess the dexterity and training to perform the necessary tasks, direct monitoring with each dose does not occur and that mechanisms must be in place to manage intravenous access problems (ie, loss of access) because these can not be self-corrected. In addition, because having patients solubilize drugs for injection is potentially unsafe, patients will need to either personally collect premixed bags of antibiotics for infusions or have them delivered (5). As a result, antibiotics that are unstable in solution may not be practical for use with self-administration.

SAFETY
There are a number of potential safety concerns associated with the treatment of infections using parenteral therapy for patients in the ambulatory setting. Most of these potential safety concerns relate to the specific complications associated with the infections per se, the route of intravenous access and reactions/intolerances to the administered drugs (18). Use of a multidisciplinary team-based approach has been emphasized in numerous publications to reduce the occurrence of potential adverse events and to improve outcomes (13,21).

A wide variety of infections have been reported as being safely treated using OPAT (2,5,7,10,11,18). It is evident that patients with severe acute infections, those who require close monitoring or adjunctive therapies (ie, oxygen, frequent blood testing, bolus intravenous fluid therapy, surgical intervention) are not good candidates for OPAT and are best managed in an inpatient setting. On the other hand, it is intuitive that chronic infections, such as extremity osteomyelitis or those acute infections that have been demonstrated to exhibit good clinical response after days or weeks of inpatient therapy, can be safely treated in the outpatient setting. These generally include

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bone and joint infections (5,22), selected cases of endocarditis (18,23-25) and deep visceral abscesses (26). Many OPAT programs have limited patient enrollment for these chronic infections (15,23,26). However, experience using OPAT management with selected acute infections, often without initial in-hospital treatment, is growing and includes infections of the skin and soft tissue; the urinary, respiratory and gastrointestinal tracts; as well as other acute infections (1,3,9,10,17,19,27-29).

While most OPAT treatments involve the use of antibiotics, OPAT may also include the use of antiviral, antifungal or antiparasitic agents.

Although some programs have relied heavily on the use of intramuscular injections, the vast majority of OPAT programs are based on the provision of intravenous injections (6). As a result, safe and reliable intravenous access is a mandatory component of OPAT. Generally, peripheral intravenous access is the simplest to obtain and provides a good option for treatments of short duration (days to weeks), whereas midline catheters and peripherally inserted central catheters are better suited for treatment durations lasting weeks to months (30). When prolonged therapy is required and the use of peripherally inserted central catheters is not feasible, some patients may require tunneled central venous catheters. Two important issues have been raised regarding this form of access for use with OPAT. Concerns exist with the use of self-administration regarding the risk for the development of infection. However, with proper training and programmatic support, this does not appear to be a limiting factor (30,31). Most programs consider injection drug use a contraindication to OPAT. However, some programs have reported success using OPAT with selected patients in this population (32).

THE INFECTIOUS DISEASES SPECIALIST AND OPAT

Although the provision of OPAT in many jurisdictions is performed by infectious diseases specialists, in other jurisdictions, there are few limitations on who may act as a provider, with generalist and specialist physicians as well as nonphysicians, in some cases, being able to prescribe OPAT therapies (33). Given their specialized expertise, it appears reasonable to assume that OPAT that is prescribed by infectious diseases specialists is more likely to be narrower in spectrum, of potentially higher efficacy and of shorter duration compared with nonspecialist care. Several studies have reported that a team-based approach that includes an infectious disease specialist leads to optimized therapy (34-36). However, infectious diseases specialists potentially must fulfill many diverse roles with respect to inpatient consultation, infection prevention and control programs, antimicrobial use and chronic infectious diseases management, such as in HIV and hepatitis clinics. As a result, human resource limitations may play a role in the ability to staff OPAT clinics solely with infectious diseases specialists.

PRESENT AND FUTURE CHALLENGES

While OPAT has provided many patients with improved satisfaction in care, saved health care resources, and helped to offload emergency departments and inpatient beds, a number of challenges and controversies remain.

Compared with inpatient care, OPAT is clearly cost saving; however, issues remain with respect to its funding because it may shift costs from hospitals to patients (7). For example, when patients are admitted to hospital in Canada, all necessary care is provided to Canadian citizens through the publicly-funded health care system. However, when discharged through OPAT, the costs of drugs and other supplies are not guaranteed to be paid through the public health care system. Of the 71 assessed inpatients who were receiving intravenous therapy in a study conducted in Vancouver (British Columbia) (37), 64 indicated a preference for further treatment at home versus in-hospital treatment, and this was associated with a median willingness to pay of $490. It is our view that OPAT should be considered and extension or replacement of inpatient care and should be funded accordingly.

Another potential consideration with the availability of OPAT is that by increasing ready access to intravenous therapy, physician referral behaviour and patient expectations may change. On one hand, efficient access to OPAT may lead to an increasing expectation for intravenous treatment of patients who may have relatively mild disease and who may be successfully treated using oral agents. On the other hand, due to increasing stress on hospital capacity in many jurisdictions, there may be expectations to treat sicker patients as outpatients who may be better treated and monitored in the hospital setting.

A central principle of antimicrobial prescription is to use the narrowest spectrum agent that has acceptable efficacy. However, many OPAT systems, especially those that use the infusion centre or in-home health care worker models, use broad spectrum drugs that have prolonged half-lives, such as ceftiraxone or ertapenem, in preference to narrower-spectrum choices that require more frequent dosing (38). This may be a practical consideration in many programs in which the only alternative may be admission to hospital. While it is quite possible that there may be an overall benefit to outpatient care and the use of once-daily broad spectrum agents compared with narrower-spectrum treatment in hospital due to less exposure to resistant organism acquisition, this remains contrary to infectious diseases teachings and practice. The availability of elastomeric and mechanical infusion pumps do provide an option for frequent dosing of agents with short half-lives and provide a suitable alternative to in-hospital treatment.

Perhaps the most significant concern with OPAT is that while it has been embraced and adopted widely, evaluation of OPAT has been largely experiential and observational in nature. Assessment of OPAT in clinical trials has been noticeably lacking (39). There are many questions regarding optimal therapeutic agents, administration route and duration, as well as programmatic and delivery issues in OPAT that remain unanswered. The increasing burden of antimicrobial resistance will inevitably have an increasing influence on OPAT practice and demand in the coming years. Given the vast number of patients treated annually using OPAT programs worldwide, we must push for greater scrutiny of our practices and argue for enhanced research resources to optimize the use of OPAT.

REFERENCES
