

A multi-method review of home-based chemotherapy

J.M. EVANS, PHD, POST-DOCTORAL FELLOW, *Institute of Health Policy, Management & Evaluation, University of Toronto, and Integrated Care Unit, Cancer Care Ontario, Toronto, ON*, M. QIU, BASC, MASTER OF SCIENCE CANDIDATE, *Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA, and Integrated Care Unit, Cancer Care Ontario, Toronto, ON*, M. MACKINNON, BPE, DIRECTOR, *Integrated Care Unit, Cancer Care Ontario, Toronto, ON*, E. GREEN, RN, BSCN, MSC(T), PROVINCIAL HEAD, *Nursing and Psychosocial Oncology, Cancer Care Ontario, Toronto, ON*, K. PETERSON, BSCN, VICE PRESIDENT, *Clinical Care, Champlain Community Care Access Centre, Ottawa, ON*, & L. KAIZER, MD, FRCP(C), PROVINCIAL HEAD, *Systemic Treatment Program, Cancer Care Ontario, Toronto, ON, Canada*

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This study summarises research- and practice-based evidence on home-based chemotherapy, and explores existing delivery models. A three-pronged investigation was conducted consisting of a literature review and synthesis of 54 papers, a review of seven home-based chemotherapy programmes spanning four countries, and two case studies within the Canadian province of Ontario. The results support the provision of home-based chemotherapy as a safe and patient-centred alternative to hospital- and outpatient-based service. This paper consolidates information on home-based chemotherapy programmes including services and drugs offered, patient eligibility criteria, patient views and experiences, delivery structures and processes, and common challenges. Fourteen recommendations are also provided for improving the delivery of chemotherapy in patients' homes by prioritising patient-centredness, provider training and teamwork, safety and quality of care, and programme management. The results of this study can be used to inform the development of an evidence-informed model for the delivery of chemotherapy and related care, such as symptom management, in patients' homes.

Keywords: chemotherapy at home, home-based chemotherapy, domiciliary chemotherapy, home care, cancer care.

INTRODUCTION

With over 32 million people living with cancer worldwide and an incidence of 14 million new cases per year (IARC 2014), the demand for oncology services, particularly

chemotherapy delivery, is growing dramatically. Chemotherapy remains a standard treatment for cancer alongside radiotherapy and surgery. Although the majority of chemotherapy is delivered in an ambulatory setting, usually associated with a specialist hospital, advances in cancer treatment modalities have made it possible to offer chemotherapy in patients' homes (Boothroyd & Lehoux 2004).

Home-based chemotherapy delivery offers several potential benefits. First, it can enhance patient-centredness by offering eligible patients more choice about how, when and where they are treated (Borras *et al.* 2001; Tralongo *et al.* 2011). Reducing the use of inpatient beds and ambulatory clinics for long infusions may also help create

Correspondence address: Jenna M. Evans, Institute of Health Policy, Management & Evaluation, Dalla Lana School of Public Health, University of Toronto, Health Sciences Building, 155 College Street, Suite 425, Toronto, ON M5T3M6, Canada (e-mail: jenna.evans@utoronto.ca).

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capacity and enhance value for money at the health system level (Joo *et al.* 2011; Corrie *et al.* 2013). Finally, moving chemotherapy, and associated follow-up care, from hospital or outpatient settings to patients' homes may contribute to broader efforts to improve the quality and safety of transitions in care between providers and settings (Boothroyd & Lehoux 2004).

Despite the potential benefits of home care alternatives, there are no best practice models outlining policy, programme and clinical standards to guide coordination and standardisation of home-based chemotherapy services. The aim of this study was to consolidate research- and practice-based evidence on chemotherapy at home, and to explore existing delivery models. The following research questions were used to guide the study:

- How is 'chemotherapy at home' defined and described in the literature?
- When and for whom is chemotherapy at home an appropriate delivery option?
- What evidence is available on the safety, quality, cost-effectiveness and patient experience of chemotherapy at home?
- What are the key components and best practices of existing chemotherapy at home programmes?
- What are the primary challenges to delivering chemotherapy in patients' homes?
- What measures are used to evaluate chemotherapy at home programmes?

To answer these questions, we conducted a three-pronged study consisting of a literature review, an international jurisdictional scan, and two case studies within the Canadian province of Ontario. The most recent literature review of home-based chemotherapy was published over 10 years ago (Boothroyd & Lehoux 2004), and to our knowledge a jurisdictional scan systematically comparing international approaches to organising, managing and delivering chemotherapy in patients' homes has not been conducted. The results of this study can be used to inform the development of an evidence-informed model for the delivery of chemotherapy (and related care) in patients' homes. In the sections that follow, we provide details of the study design and results, organised by method, as well as recommendations for programme design and delivery.

METHODS

Literature review

The review was focused on the delivery of *parenteral* chemotherapy in *adult* patients' homes. A search of the

academic and grey literature was conducted using Google Scholar and PubMed, and supplemented by hand searches of the reference lists of included papers. Papers had to be published in English. No limit was placed on year of publication, or on methods or methodological quality. The following search terms were used: chemotherapy at home, home-based chemotherapy, home chemotherapy, domiciliary chemotherapy and chemotherapy in home care. Papers and programmes focused exclusively on oral chemotherapy, paediatric populations or on the delivery of chemotherapy in ambulatory settings (with no home care component) were excluded.

A systematic data extraction method was used to identify and record important information from each of the papers for comparison and synthesis. The following information was extracted: author(s) and year; purpose of the study; context/setting; methods; patient eligibility criteria; service and treatment details; programme management/organisation and components; programme delivery/steps; providers involved; evaluation metrics; results; and study limitations. Themes in the literature were identified using thematic analysis. This involved comparing the content of extracted data from across the included papers to identify the main, recurrent or most important topics and issues arising from the literature (Mays *et al.* 2005).

Jurisdictional scan

A combination of convenience, purposeful and snowball sampling was used to identify domestic and international home-based chemotherapy programmes. We began by consulting administrative and clinical experts within Cancer Care Ontario (CCO) to identify well-known programmes within Canada. CCO is a provincial agency tasked with ensuring cancer services are well planned and coordinated across the province. Consultation with CCO staff led to the identification of programmes in the provinces of Alberta and British Columbia. We then identified international jurisdictions and health systems that are comparable to Canada in terms of healthcare funding and delivery (e.g. England and Australia) and that have a reputation for outstanding healthcare performance (e.g. Cleveland Clinic in the United States). We conducted Internet searches to identify home-based chemotherapy programmes within these jurisdictions and systems, and, in some cases where there was a lack of information available online, we requested recommendations on which programmes to examine from regional or national cancer organisations. This resulted in a sample of seven programmes from five countries. We sent invitations via e-mail to programme leaders telling them about the work of CCO and inviting

them to discuss their programme with us. All seven programme representatives agreed to participate in a teleconference and to share key documents with us (100% response rate).

Documents describing each programme and any evaluations conducted were requested and, where available, provided by programme contacts. A systematic data extraction method was used to identify and record important information from the documents, including programme name; location; year started; size of programme; services offered; treatments offered and source of drugs; patient eligibility criteria; programme organisation and management; programme delivery/steps; processes for quality and safety; providers involved; and evaluation metrics and results.

The document analysis was supplemented by semi-structured interviews conducted via teleconference with a convenience sample of programme administrators and providers from the seven programmes ($n = 10$) to acquire descriptive, structural and operational information as well as performance data, if available. The interview guide is provided in Appendix 1. Each participant was informed that the primary purpose of the interview was to inform CCO's efforts to develop provincial recommendations for chemotherapy at home, and second to contribute to knowledge through potential publication in the academic literature. Participants were assured that their names and direct quotes would not be used in any subsequent publications, but that general information on the programme, including the programme name and location, would be used. Consent was implied by each person's participation in the interview. The interviews were not recorded. Detailed notes were taken during the interviews and cross-checked with documentation and other teleconference participants, including both participating CCO staff members and the interviewees. Upon completion of the interviews, recurrent themes across the programmes were identified from programme documentation and interview notes using thematic analysis.

Case studies

Case studies of two home-based chemotherapy programmes in Ontario were conducted. The aims of the case studies were to deepen our understanding of how such programmes function, build on the jurisdictional scan, and support comparison of programmes across diverse local, national and international settings. Case studies of home-based chemotherapy services were conducted for two of Ontario's 14 Local Health Integration Networks (LHINs): the Champlain LHIN and their Chemotherapy Home Infu-

sion Pump Program (CHIPP), and the Toronto Central (TC) LHIN. LHINs are the health authorities responsible for regional administration of healthcare services in Ontario. Each of the 14 LHINs is mandated with planning, integrating and distributing provincial funding for all public healthcare services within their regional boundaries.

The two cases were selected to maximise variation for the purpose of enhancing comparison, learning and generalisation (Patton 2002). CHIPP is a comprehensive and well-established programme with standardised structures and protocols for programme operation, care delivery and performance measurement. The TC LHIN, however, does not have a standardised programme for home-based chemotherapy, resulting in the use of various models and methods. Furthermore, the geographies and demographics of the two LHINs vary. In the Champlain LHIN, one in five residents lives in rural areas, one in five residents is a Francophone, and at least 32 000 people are Aboriginal (Champlain LHIN 2013). The TC LHIN, on the other hand, is the only LHIN that is completely urban, and it has the highest concentration of new immigrants and low-income persons in the province (Toronto Central LHIN 2013). The differences between the two LHINs and their approaches to home-based chemotherapy produce information rich cases likely to generate new knowledge (Patton 2002).

The case studies of these two regions involved interviews with staff members and the development of maps detailing the process by which chemotherapy is delivered to patients at home. A process map is a graphic representation of the sequence of steps in a process that reflects major blocks of activity, individual roles, information flows, and tool or database use. Process maps capturing home-based chemotherapy delivery were built, based on documentation provided by staff members in each LHIN. Further data were obtained through phone and in-person interviews with diverse staff members from CHIPP and TC.

For CHIPP, interviews were conducted with representatives from The Ottawa Hospital Cancer Centre and the Champlain Community Care Access Centre (CCAC), including care coordinators and facilitators, a pharmacist, an oncology nurse and a manager ($n = 7$). For the TC LHIN, representatives from several organisations were interviewed, including the TC CCAC, three hospitals and a home care agency ($n = 17$). Interviewees occupied a variety of roles including manager, nurse, educator and care coordinator. The interview guide is provided in Appendix 2. Participants were assured that their names and direct quotes would not be used in any subsequent publications, but that general information on the pro-

gramme, including the programme name and location, would be used. Consent was implied by each person's participation in the interview. The interviews were not recorded. Detailed notes were taken during the interviews and cross-checked against documentation and with the participants post-interview. The process maps were also validated with staff members from each programme.

RESULTS

Literature review

The literature search yielded 604 papers. After the removal of duplicates, 506 papers remained. The titles and abstracts of these papers were screened for relevance, resulting in the exclusion of 432 papers. After a full-text review, another 15 papers were excluded. Excluded papers frequently focused on paediatric populations, oral chemotherapy, diseases other than cancer such as tuberculosis or they mentioned home-based chemotherapy in passing only. Some excluded papers were also not available in English, and a few were inaccessible. The final review included 54 papers with the following characteristics: 61% were published since 2000 (33/54), 28% were published in the 1990s (15/54) and 11% in the 1980s (6/54). Most of the papers are empirical (72%) including eight randomised controlled trials. Table 1 provides a brief overview of the included studies, organized by method into four categories: literature reviews, randomized controlled trials, observational studies, and discussion papers.

The two most commonly cited definitions in the literature of 'chemotherapy at home' are:

- 'any type of administration of cancer chemotherapeutic agents at home (intravenous, subcutaneous, oral, etc.) with or without on-site supervision by a nurse' (Boothroyd & Lehoux 2004) and
- 'a service that provides a package of care to support the administration of chemotherapy to patients in their homes by specialist healthcare professionals (usually nurses)' (Young & Kerr 2001; Bazian Ltd 2010).

Oral chemotherapy is not always considered home chemotherapy, and in some contexts, home chemotherapy is strictly used to refer to treatment which is entirely carried out by a nurse in the home (Boothroyd & Lehoux 2004; Tralongo *et al.* 2011). Some distinguish between 'home chemotherapy' where the entire process is carried out in the home setting and 'partial-at-home-services' where the first chemotherapy infusion or oral drug is given in the hospital/clinic and later courses or cycles are completed at home and/or when some visits to the hospital or

clinic are still required for blood tests and monitoring (Gavin *et al.* 2004; Bazian Ltd 2010; Tralongo *et al.* 2011). As a response to a medication error and process review by experts, Ewen *et al.* (2012) described a case in which chemotherapy at home was re-defined such that the clinic/hospital always initiates chemotherapy as standard operating procedure and the home care agency is always responsible for disconnection.

Drawing from the literature as well as local stakeholder consultation and consensus, a customised definition was developed for internal use of the term 'chemotherapy at home' within CCO. We define *chemotherapy at home* as a service that provides a package of care to support patients with their parenteral chemotherapy treatment at home. This service refers to parenteral chemotherapy only, with the first dose always initiated in hospital, though subsequent doses may be initiated at home. The package of home care services, and the patient pathway between hospital and community settings, will vary according to patient needs, eligibility and preferences. Services offered in the home may include standard nursing care, chemotherapy administration, Central Venous Access Device (CVAD) management, infusion pump changes and disconnects, patient/caregiver education, symptom management and medication reconciliation.

Although the evidence base is not complete or conclusive, results of empirical research suggest that home-based chemotherapy is a safe, preferred and potentially cost-effective alternative to hospital-based delivery. Studies report no differences in the rates of adverse events between hospital-based or outpatient chemotherapy and home-based chemotherapy, though device-related complications at home are common (Malone *et al.* 1986; Lowenthal *et al.* 1996; Brown *et al.* 1997; Herrmann *et al.* 1999; Westermann *et al.* 1999; Rischin *et al.* 2000; Borrás *et al.* 2001; Boothroyd & Lehoux 2004; Inaba *et al.*, 2007; Kodama *et al.* 2007; Bupa 2010; Bazian Ltd 2010; Luthi *et al.* 2012; Corrie *et al.* 2013; Crisp *et al.* 2014). One study even reports lower toxicity among patients receiving home-based chemotherapy (Barker 2006). The evidence suggests that staff, patients and informal caregivers must be carefully selected and trained (Stevens 1989; Chrystal 1997; Dougherty *et al.* 1998; Hayward 2002; Hirtzlin & Preaubert-Hayes 2005; Molloy *et al.* 2008; Kodama *et al.* 2009), given concerns such as drug stability, safe handling of chemotherapy and device management (Vokes *et al.* 1989; Beijnen 1992; Grajny *et al.* 1993; Moore *et al.* 1996; McKenzie 2000; Benziri *et al.* 2009).

Table 1. Overview of academic papers and reports on home-based chemotherapy

Author(s) (year)	Purpose	Methods
<i>Literature reviews</i>		
Bazian Ltd (2010)	To report differences in effectiveness, safety and acceptability for adult patients receiving chemotherapy in the home setting versus the hospital setting	Literature review of randomised controlled trials and observational studies ($n = 20$)
Boothroyd and Lehoux (2004)	To review the evidence on home-based chemotherapy, including effectiveness, patient safety, patient preference and satisfaction, patient quality of life, and cost	Literature review; semi-structured interviews with service providers at organisations in Quebec ($n = 10$) and Ontario ($n = 6$)
Bupa (2010)	To identify and summarise evidence published on the safety of home-based chemotherapy	Narrative review ($n = 18$)
Hirtzlin and Preaubert-Hayes (2005)	To conduct a cost comparison of chemotherapy delivery in the hospital versus in the home via a 'Hospital at Home' programme or a care network	Literature review, examination of French data, and expert review and consensus
Smeenk <i>et al.</i> (1998)	To investigate whether for patients with incurable cancer comprehensive home care programmes are more effective than standard care	Systematic review of nine prospective controlled studies
<i>Randomised controlled trials</i>		
Borras <i>et al.</i> (2001)	To compare home-based chemotherapy with outpatient treatment in terms of colorectal cancer patients' safety, compliance, use of health services, quality of life and satisfaction with treatment	Randomised controlled trial with 87 patients, 45 receiving treatment at home and 42 in an outpatient setting
Corrie <i>et al.</i> (2011)	To describe the study protocol for the OUTREACH Trial which aims to compare delivery of cancer treatment in a hospital day unit, GP office and at home	Three-arm randomised controlled trial using mixed methods to examine patient quality of life, patient satisfaction, service use, cost data, compliance with treatment and patient safety
Corrie <i>et al.</i> (2013)	To compare delivery of cancer treatment in a hospital day unit, GP office and at home (referred to as the OUTREACH Trial)	Three-arm randomised controlled trial using mixed methods and involving 97 patients, 57 of which completed the study
King <i>et al.</i> (2000)	To compare the costs and outcomes of home and hospital-based chemotherapy, including patient and caregiver preference and satisfaction, unmet patient needs and patient quality of life	Prospective randomised crossover trial with 40 patients
McCorkle <i>et al.</i> (1989)	To compare and assess the effects of home nursing care for patients with progressive lung cancer	Randomised clinical trial using interviews with 166 patients assigned to receive care from oncology home care nurses, regular home care nurses or clinic-based care
Remonay <i>et al.</i> (2002)	To compare the costs of chemotherapy delivery via hospital at-home care versus a hospital day-care unit	Randomised controlled crossover trial involving 42 patients
Rischin <i>et al.</i> (2000)	To determine patient preference and cost differences between home-based and hospital-based chemotherapy delivery	Randomised crossover trial involving 20 patients
Vokes <i>et al.</i> (1989)	To evaluate the safety, reliability, and patient acceptance of outpatient home-based continuous intravenous infusion chemotherapy	Randomised crossover trial involving 22 patients receiving standard inpatient chemotherapy or outpatient chemotherapy using an infuser
<i>Observational studies</i>		
Anderson <i>et al.</i> (2003)	To investigate the feasibility and acceptability of administering single-agent gemcitabine to patients with advanced non-small-cell lung cancer in their own homes	Questionnaires and interviews with 24 patients to examine quality of life, subjective health status, anxiety and depression and caregiver strain. Also examined resource utilisation, toxicity, adverse events and disease status
Barker (2006)	To compare toxicity in patients receiving home-based chemotherapy to those receiving chemotherapy in an outreach clinic	Audited 14 patients (7 in each setting) over a 6-month period to track side effects
Benziri <i>et al.</i> (2009)	To identify which anticancer drugs with sufficiently long stability could be eligible for use in home-based chemotherapy and to propose a standardisation of their stability data	Questionnaire with six hospital pharmacies regarding their stability data. Results compared to marketing authorisation data

Table 1. *Continued*

Author(s) (year)	Purpose	Methods
Brown <i>et al.</i> (1997)	To determine the frequency of complications in patients receiving chemotherapy with implantable venous access devices; to determine whether complications were associated with the mode of chemotherapy delivery (push/bolus or infusional regimens); and to evaluate the influence of other risk factors such as home-based versus hospital-based administration	152 oncology patients who underwent surgical placement of an Infus-a-Port were evaluated retrospectively for post-placement device complications
Christopoulou (1993)	To investigate the biosocial factors affecting cancer patients' decision to receive treatment at home or in hospital	Survey-based interviews with 184 patients
Cox <i>et al.</i> (1996)	To describe an ambulatory home-based chemotherapy programme	Description of programme and review of patient files for 74 participants to examine type of pump used, VAD problems, infections and complications
Crisp <i>et al.</i> (2014)	To explore the perspectives of adult patients receiving home chemotherapy	Interviews with 10 patients receiving home chemotherapy as part of a broader pilot project involving 89 patients
Ewen <i>et al.</i> (2012)	To describe a medication error which occurred during the delivery of home-based chemotherapy, and the clinical team's performance improvement journey	Case study
Gavin <i>et al.</i> (2004)	To explore community nurses' experiences, attitudes and concerns towards delivery of home-based chemotherapy	Literature review; interviews with a clinical nurse manager and two higher education lecturers; focus group with 12 district nurses; in-depth interviews with 6 district nurses
Hall and Lloyd (2008)	To compare the experiences of breast cancer patients who received chemotherapy at home with those who were treated in hospital	Semi-structured interviews and cost analysis with 15 patients who were randomised to receive chemotherapy at home ($n = 10$) or in hospital ($n = 5$)
Herrmann <i>et al.</i> (1999)	To compare the rate of infections among patients receiving stem cell rescue, chemotherapy and clinical care at home versus in hospital as an inpatient	Measured infection rate, complication rate, and survival rate for 51 patients who received care at home and 88 who received care as inpatients
Inaba <i>et al.</i> (2007)	To analyse the frequency and type of complications involving CV-ports and portable disposable pumps among patients undergoing home chemotherapy	Retrospective review of medical records for 232 patients receiving home chemotherapy
Joo <i>et al.</i> (2011)	To compare the economic- and patient-reported outcomes between outpatient home-based and inpatient hospital-based chemotherapy in advanced colorectal cancer patients	Patient satisfaction survey and cost analysis for 80 patients, 40 received home-based chemotherapy and 40 received hospital-based chemotherapy
Kelly <i>et al.</i> (2004)	To examine an existing outpatient chemotherapy service and consider the feasibility, accountability and cost-effectiveness of introducing a home-based model	Literature review; in-depth interviews with patients with colon cancer ($n = 5$) and care providers ($n = 12$) regarding present service; analysis of service contracts and financial estimates
Kodama <i>et al.</i> (2009)	To explore the delivery of home care for the treatment of haematological malignancies in elderly patients	Reviewed medical charts and history for 15 patients, spoke with their attending physicians, and conducted questionnaires with patients
Kodama <i>et al.</i> (2007)	To report the case of a patient who received home-based chemotherapy, and to discuss its feasibility and obstacles	Case study of 80-year old patient with advanced follicular lymphoma
Lal <i>et al.</i> (2013)	To describe a study protocol for examining the feasibility of home-based chemotherapy	At least 50 patients will be followed and the following measures tracked: adherence to home-based care, patient safety, patient quality of life, patient and physician satisfaction and healthcare resource use and costs
Lowenthal <i>et al.</i> (1996)	To assess the safety and to analyse the cost-effectiveness of home treatment, including cytotoxic chemotherapy, for cancer patients	Restrospective overview of a home oncology nursing service over its first 5 years (1989–1994), and a detailed cost analysis over 12 months

Table 1. *Continued*

Author(s) (year)	Purpose	Methods
Luthi <i>et al.</i> (2012)	To evaluate the feasibility, safety, perception and costs of home care for the administration of intensive chemotherapies	Questionnaires, tracking of complications and mechanical problems, and cost evaluation with 17 patients who underwent 46 treatment cycles collectively
Malone <i>et al.</i> (1986)	To compare hospital-based chemotherapy with home-based chemotherapy	Interviews with 15 women and prospective tracking of their experiences and outcomes
McCorkle <i>et al.</i> (1994)	To compare symptom distress, mental health status, enforced social dependency and health perceptions among patients receiving home care services compared with those receiving no such services	Two interviews per patient for 49 patients who received home care and 11 who did not; questionnaires completed via interview or self-administered with interviewer present
McKenzie (2000)	To outline the process of developing chemotherapy standards for a Hospital in the Home (HITH) programme and to describe the results of a pilot project and the implications for nursing practice	Five HITH programmes evaluated the newly developed standards against their own programmes as they currently operate
Molloy <i>et al.</i> (2008)	To examine the views and experiences of patients receiving chemotherapy at home via a PICC-line	Two-stage descriptive study consisting of interviews with 10 patients and a questionnaire with 69 patients
Ophof <i>et al.</i> (1989)	To report the experiences of patients receiving home-based chemotherapy	Questionnaires and tracking of 99 patients
Raphael <i>et al.</i> (2005)	To compare, from the payer's point of view, the cost of home-based chemotherapy (and other treatments) with the estimated cost of treating the same patients in a standard hospital setting	Prospective cost analysis of 82 patients who received home-based care; these costs were then compared to hypothetical hospital treatment for each patient
Rowe <i>et al.</i> (2002)	To assess the feasibility, patient acceptability, effect on patient quality of life, and comparative cost of administering the deGramont regimen on an outpatient basis using elastomeric infusion devices	Prospective, single-centre observational study of 26 patients receiving the deGramont regimen, 13 as inpatients and 13 as outpatients
Vinciguerra <i>et al.</i> (1986)	To compare outcomes of home and hospital comprehensive treatment for advanced cancer patients	Prospective comparative analysis of 174 patients treated at home and 44 in hospital
Westermann <i>et al.</i> (1999)	To report the results of an outpatient, home treatment programme for patients receiving one or more high-dose chemotherapy courses with stem cell rescue	Questionnaires used and data collected on treatment, unscheduled consultations, and readmissions for 42 patients, 11 inpatient, 18 outpatient (15 of which stayed at home), and 13 at home
<i>Discussion papers</i>		
Beijnen (1992)	To discuss the pharmacists' concerns regarding stability and compatibility of chemotherapy drugs for administration in patient homes	Editorial
Catania (1999)	To provide an overview of basic concepts and issues related to home chemotherapy delivery	Discussion paper
Chrystal (1997)	To discuss the role and requirement of nurses in home-based chemotherapy delivery and patient selection	Discussion paper
Dougherty <i>et al.</i> (1998)	To discuss requirements for and benefits of ambulatory home-based chemotherapy delivery	Discussion paper
Grajny <i>et al.</i> (1993)	To discuss issues related to safe administration of chemotherapy drugs in a home environment	Discussion paper
Hayward (2002)	To discuss home-based chemotherapy delivery and report one programme experience	Discussion paper (additional methods unclear, full paper inaccessible)
Main and Unwin (2008)	To discuss various considerations in the delivery of home-based chemotherapy	Discussion paper
Moore <i>et al.</i> (1996)	To present issues and considerations in the selection of infusion devices and the nursing role in the management of patients utilising such devices at home	Discussion paper
O'Neill and Wallis (2009)	To review evidence and experiences on home healthcare with a focus on chemotherapy delivery	Discussion paper

Table 1. *Continued*

Author(s) (year)	Purpose	Methods
Stevens (1989)	To discuss the safe handling of chemotherapy in the home setting by care providers, patients, and informal caregivers	Discussion paper
Tralongo <i>et al.</i> (2011)	To describe a cancer patient-centred home care model	Discussion paper
Watters (1997)	To discuss the benefits of and requirements for providing chemotherapy at home	Discussion paper
Young and Kerr (2001)	To define and discuss evidence on home-based chemotherapy delivery	Editorial

In the studies we reviewed, 5FU (fluorouracil) was the most common chemotherapy drug provided in patient homes (Vokes *et al.* 1989; Cox *et al.* 1996; Rischin *et al.* 2000; Rowe *et al.* 2002; Boothroyd & Lehoux 2004; Gavin *et al.* 2004; Inaba *et al.*, 2007; Molloy *et al.* 2008; Bazian Ltd 2010; Joo *et al.* 2011; Ewen *et al.* 2012). An observational study conducted with 17 patients in Switzerland in 2012 involved the use of intensive chemotherapies such as high-dose cyclophosphamide, melphalan and ifosfamide–adriamycin (Luthi *et al.* 2012). Many of the drugs used in the study by Luthi *et al.* (2012) – including high-dose methotrexate, cisplatin, ifosfamide and cyclophosphamide – were excluded from delivery at home in France, as of 2003, due to complexities (i.e. short-term toxicity, intensive hydration, vigorous diuresis protocols and/or lack of data), except on a case-by-case basis. In France, first cycles of high-dose ifosfamide and cyclophosphamide, and of rituximab and trastuzumab, were always given in the hospital. It is possible, however, that these guidelines have evolved in the last 10 years. According to a 2004 review of home-based chemotherapy, VAD and high-dose methotrexate, cisplatin, ifosfamide and cyclophosphamide have been used in home settings with no significant complications (Boothroyd & Lehoux 2004).

There are often no differences found in patient quality of life and satisfaction, or in healthcare utilisation such as ED visits, between hospital-based or outpatient chemotherapy and home-based chemotherapy; where differences have been found, they are in favour of home care (Malone *et al.* 1986; Vinciguerra *et al.* 1986; Ophof *et al.* 1989; Christopoulou 1993; McCorkle *et al.* 1994; Smeenk *et al.* 1998; Westermann *et al.* 1999; King *et al.* 2000; Rischin *et al.* 2000; Borrás *et al.* 2001; Rowe *et al.* 2002; Anderson *et al.* 2003; Boothroyd & Lehoux 2004; Hirtzlin & Preaubert-Hayes 2005; Bazian Ltd 2010; Joo *et al.* 2011; Luthi *et al.* 2012; Corrie *et al.* 2013; Crisp *et al.* 2014). Several papers report that a small minority of patients

express serious concerns about home-based chemotherapy and/or explicitly prefer hospital treatment, thus emphasising the importance of patient education and patient choice (Ophof *et al.* 1989; Herrmann *et al.* 1999; Westermann *et al.* 1999; Rowe *et al.* 2002; Kelly *et al.* 2004; Hirtzlin & Preaubert-Hayes 2005; Hall & Lloyd 2008; Molloy *et al.* 2008; Bazian Ltd 2010; Joo *et al.* 2011).

The cost outcomes of home-based chemotherapy vary by context, programme structures, delivery protocols and how ‘cost’ is measured, particularly since home-based chemotherapy can cause cost shifting within the healthcare system from hospitals to home care organisations and patients and their families (Boothroyd & Lehoux 2004). Reviews of the literature published in 2004 and 2005 report mixed cost outcomes (Boothroyd & Lehoux 2004; Hirtzlin & Preaubert-Hayes 2005). Although home-based chemotherapy is generally less costly than inpatient hospital treatment, it may not be less costly than outpatient treatment (Boothroyd & Lehoux 2004; O’Neill & Wallis 2009). However, two more recent randomised controlled trials conducted in the UK have found no differences in cost between hospital, outpatient and home chemotherapy delivery (Hall & Lloyd 2008; Corrie *et al.* 2013); these results mirror similar studies (Vokes *et al.* 1989; Raphael *et al.* 2005). Furthermore, three observational studies conducted in Switzerland, the United Kingdom and Korea have found a significant cost–benefit associated with home-based chemotherapy compared with inpatient treatment (Rowe *et al.* 2002; Joo *et al.* 2011; Luthi *et al.* 2012). Additional studies are required.

Jurisdictional scan

Results of the jurisdictional scan confirmed that successful and mature home-based chemotherapy programmes exist. Furthermore, the number of recent pilot projects identified demonstrates increasing demand and interest in home chemotherapy delivery. Seven national and international programmes were selected for further study and

comparison: two from Canada, two from the UK, two from the US and one from Australia. The programmes include:

- Cancer Treatment at Home Pilot Project, Cross Cancer Institute (Edmonton, Alberta, Canada)
- Chemotherapy in the Community Pilot, Clatterbridge Cancer Centre (Merseyside, UK)
- Community Oncology Nursing Programme (Ireland, UK)
- Home Discontinuation Program (British Columbia, Canada)
- HomeMed Program, University of Michigan Hospital & Health Centers (Michigan, USA)
- Infusion Pharmacy at Home Program, Cleveland Clinic (Ohio, USA)
- Oncology Hospital-in-the-Home Program (Victoria, Australia).

Of the seven programmes identified, four involve the administration of chemotherapy in patient homes, while three provide services associated with chemotherapy treatment, including CVAD management and infusor discontinuation. While the latter set of programmes does not involve chemotherapy administration, they offer insight into related models of care and home-based services associated with chemotherapy treatment. Programme details are outlined in Table 2.

Anecdotal evidence and performance evaluation reports from these programmes reflect the academic literature: no major safety incidents, high patient and family satisfaction, and 5FU is the most common drug offered. We also found that most of the programmes were physician-driven in terms of development and implementation.

Summary of results: literature review and jurisdictional scan

In terms of programme structure, the literature review and jurisdictional scan demonstrate that hospital nurses play a key role in determining patient eligibility, conducting the first detailed assessment and providing patient education/training (King *et al.* 2000; Boothroyd & Lehoux 2004; Kodama *et al.* 2007; Corrie *et al.* 2013). More formalised programmes have full-time hospital-employed home chemotherapy nurses or they assign a primary nurse to each home chemotherapy patient who is responsible for providing and managing care (Boothroyd & Lehoux 2004; Hall & Lloyd 2008). In some models, patients are supported by nurses that are employed by public health or home care agencies with defined links to the hospital,

such as communication protocols with the oncologist and hospital nurses (Westermann *et al.* 1999; Remonnay *et al.* 2002; Gavin *et al.* 2004; Main & Unwin 2008). Some programmes involve support by a formal multidisciplinary team that includes a variety of hospital and community staff; although this is not the norm, it is the ideal approach (Vinciguerra *et al.* 1986; Watters 1997; Smeenk *et al.* 1998; Catania 1999; Bazian Ltd 2010; Tralongo *et al.* 2011). Hospital pharmacies usually prepare the chemotherapy drugs used in at-home treatments (Hirtzlin & Preaubert-Hayes 2005; Luthi *et al.* 2012; Corrie *et al.* 2013).

On the basis of the literature review and jurisdictional scan, we identified four key themes: (1) patient-centredness, (2) safety and quality of care, (3) professional education, accountability and teamwork and (4) continuity and coordination of care. The success factors and guidelines associated with these four themes are reflected in the recommendations described at the end of the paper. We also developed five 'Easy Reference Tables' to consolidate and summarise the key findings from the literature review and jurisdictional scan, and to facilitate knowledge translation. These tables address the following topics:

- Services offered through home-based chemotherapy programmes (Table 3)
- Patient eligibility criteria for home-based chemotherapy (Table 4)
- Patient views and experiences of home-based chemotherapy (Table 5)
- Chemotherapy drugs offered in patient homes (Table 6).

These tables consolidate information from various home-based chemotherapy programmes and the academic literature. Appropriate services and drugs as well as patient eligibility criteria will vary based on the aims, scope and design of the programme and the target demographic. For example, Table 4 shows that a common criterion for patient eligibility is that they live within 1 h of the hospital. However, some home-based chemotherapy programmes may be specifically set up to reach patients in rural areas.

Case studies

Chemotherapy Home Infusion Pump Program, Champlain LHIN

The Chemotherapy Home Infusion Pump Program (CHIPP) began at The Ottawa Hospital Cancer Centre (TOHCC) in December 2006. The programme is a partner-

Table 2. Jurisdictional scan: summary of home-based chemotherapy programmes

Name	Location	Programme overview
<i>Programmes that administer chemotherapy in patient homes (n = 4)</i>		
Cancer Treatment at Home Pilot Project	Cross Cancer Institute, Edmonton, Alberta, Canada	<ul style="list-style-type: none"> • 13-month pilot project in 2009–2010 • 89 patients participated in the pilot and an average of 35 were treated per month • A total of 750 home and workplace visits were made • Programme not continued despite success due to provincial restructuring and a lack of ongoing funding
HomeMed Program	University of Michigan Hospital & Health Centers, Michigan, USA	<ul style="list-style-type: none"> • HomeMed is a home infusion provider and licensed pharmacy • Has offered home-based chemotherapy since 1992 • See an average of 170 patients per month with a 6–10% increase in demand annually • Involves a multidisciplinary team and close working relationships with the Cancer Centre and visiting nurse agencies
Oncology Hospital in the Home Program	Western Health, Victoria, Australia	<ul style="list-style-type: none"> • Operating since 2006 out of a chemotherapy day unit • 6–7 home visits per day. Average travel time between homes is 20 min • Nurses stay in the patient home for the duration of the infusion (usually 30 min) or discontinue a longer infusion that was started in the day unit
Chemotherapy in the Community Pilot	Clatterbridge Cancer Centre, Merseyside, UK	<ul style="list-style-type: none"> • Pilot took place in 2013–2014 • Nurses stay in the patient home for the duration of the infusion (usually 30 min) or discontinue a longer infusion that was started in the day unit • See an average of six patients per day. The average visit is 90-min long
<i>Programmes that deliver services associated with chemotherapy treatment (n = 3)</i>		
Infusor Home Discontinuation Program	BC Cancer Agency, British Columbia, Canada	<ul style="list-style-type: none"> • Pilot in 2008; programme in operation since then • Patients come to an ambulatory chemotherapy unit to initiate the infusion. The infusors are then disconnected and VADs flushed by an informal caregiver at home. Home discontinuation of infusors by an informal caregiver is now the standard of care • Formal 30-min training session are provided to patients and informal caregivers
Community Oncology Nursing Programme Pilot	National Cancer Control Program, Ireland, UK	<ul style="list-style-type: none"> • Pilot in 2011, and now being rolled out nationally • CVAD management and disconnection of infusors at home by public health nurses (PHNs) • PHNs completed 20-week specialised training course and provided with a comprehensive 'resource book'. Programme has received university accreditation
Infusion Pharmacy at Home Program	Cleveland Clinic, Ohio, USA	<ul style="list-style-type: none"> • In operation since at least 1996 • At its peak, the programme saw 35 patients per month. Due to a hospital closure, the programme was downsized, and they currently see 15 patients. • Patients are sent home with infusions and usually return for disconnections. • Dedicated nurse in the cancer centre, employed by the programme

ship between TOHCC, the CCAC, contracted community pharmacies and external nursing agencies. CHIPP is recognised as being collectively owned by the Champlain CCAC and TOHCC, operating out of both sites of TOHCC (Queensway-Carleton Site and the Irving Greenburg Centre). The Champlain CCAC is physically situated within TOHCC, which facilitates communication and cooperation.

CHIPP is a well-structured programme supported by protocols, clear delineation of responsibilities and accountabilities between providers, distinct coding of patients to facilitate data collection, and a dedicated programme coordinator. The programme offers a number of services supporting home-based chemotherapy. Primarily, patients enrolled in the CHIPP programme are able to go home with their chemotherapy infusor, and then have

Table 3. Services offered through home-based chemotherapy programmes

Type of service	Examples
Standard nursing care	Head to toe assessment Vital signs monitoring Blood sampling Dressing changes
Chemotherapy administration and management	Chemotherapy administration Central venous access devices management (insertion, flushing, locking, troubleshooting) Infusion pump changes and disconnects
Supportive and/or palliative care	Symptom management (i.e. nausea, vomiting, pain, diarrhoea, constipation, bleeding, confusion, lethargy, etc.) Administration of fluids for hydration Immunotherapy Intravenous feeding Anti-oedema treatment Subcutaneous and intramuscular injection (GCSF, hormone, EPO, Anticoagulant Subcutaneous Medications, MABs) Patient/family support
Safety and coordination	Patient/family education Medication management/reconciliation Emergency management (cardiovascular, neurological, metabolic, haematological) System navigation and care transitions management

their infusor disconnected in the community without having to return to the hospital. Nursing services that patients receive in the home include flushing of CVAD devices; education and symptom management; 5FU pump connect (for some patients); 5FU pump disconnect; 5FU pump reconnect; and 5FU cassette changes. CHIPP saw an average of 243 patients a month in 2012–2013.

Toronto Central LHIN

Within the TC LHIN, there is no single programme to deliver chemotherapy in patients' homes. Instead, delivery of home-based chemotherapy is dependent on which of the six hospitals a patient receives treatment at: Princess Margaret Hospital (PMH), Sunnybrook Health Sciences Centre (SHSC), Mount Sinai Hospital, Toronto East General (TEG) Hospital, St. Michael's Hospital (SMH) and St. Joseph's Hospital.

All home care services are coordinated by the TC CCAC. Coordination and planning of services is also dependent on the hospital that the referral is received from. TC LHIN patients receive essentially the same set of services in the home as those provided through CHIPP.

One additional service available to TC patients is having a pump connection in the home; this is the standard method of care delivery for all patients at SMH, and a small subset of patients at PMH. The TC CCAC saw a total of 752 patients in 2013–2014 and 1016 patients in 2012–2013 for home-based chemotherapy.

Significant variation was found between the CHIPP and TC LHINs programmes, particularly in service delivery methods and protocols, as shown in Table 7 and as reflected in the process maps created for each programme (Files S1 and S2). A number of challenges were identified at both sites. Some challenges are unique to the TC LHIN, but there were also common challenges across both CHIPP and TC. Common challenges include:

1. A lack of standardisation in provider and patient education
There is wide variation in the type of education that providers and patients receive, and how they receive it, which can result in inconsistencies in service delivery between and within regions and poor quality of care. Not all home care providers are trained to work with chemotherapy, which can result in patients returning to the hospital to have their pump disconnected.
2. A lack of a documented and/or detailed patient pathway
The challenges experienced in documenting each programme's current state, such as conflicting information, reflect a fragmented patient pathway and a lack of awareness of the pathway and respective roles among different providers involved in the process.
3. A lack of standardised safety and adverse event protocols
Without standardised protocols for managing safety and reporting adverse events, the end result may be delays in receiving appropriate care or avoidable visits to the ED.
4. High costs as a result of additional resources required in the community
The cost of delivering chemotherapy at home is frequently greater than the cost of delivering chemotherapy in hospital because of higher nursing costs (due to travel costs, not due to salaries which tend to be higher in hospital) and equipment costs. A potential opportunity to decrease overall costs of chemotherapy delivery is to increase the capacity of community nursing clinics. Community-based care continues to provide patients with the convenience of receiving care closer to home, while reducing nursing, transportation and supply costs needed for home-based care. It is important to

Table 4. Patient eligibility criteria for home-based chemotherapy

Eligibility criteria	Descriptions	Details/comments
Patient & Caregiver Readiness	Preference, consent, acceptance of role and learning capacity	<ul style="list-style-type: none"> • Patient is aware of risk factors • Patient <i>prefers</i> home care and gives consent • Family and caregiver(s) prefer or are comfortable with home care, and accept their roles • Patient and caregivers are willing to be educated and have minimum skills needed to carry out treatment (i.e. self-care, personal hygiene, physical abilities, cognitive skills)
Diagnosis	Type, body site and stage of cancer	<ul style="list-style-type: none"> • Breast, colorectal, anal, oesophageal, head/neck, gynaecological, lymphoma and multiple myeloma • Less common for patients with haematological malignancies than solid tumours due to frequency of serious complications
Patient Characteristics & Co-morbidities	Functional status, language, physical, emotional and cognitive state	<ul style="list-style-type: none"> • Karnofsky or ECOG performance status (≤ 2 or ≤ 3) • No English language barriers or communication difficulties • No extreme fatigue or weakness • No multiple chronic or unstable health conditions • No severe physical disabilities • Patient has learnt to cope with their disease; No feelings of isolation, agitation or confusion, dementia or delirium, persistence of symptoms under treatment, or severe anxiety or depression
Treatment Regimen & Patient's Previous Response to Treatment	Cytotoxic drugs used, dosage/intensity, route of administration, administration schedule and duration of therapy	<ul style="list-style-type: none"> • Not an unlicensed drug as part of a clinical trial • Treatment protocol is suitable for home delivery (i.e. several doses of the same drug are required on consecutive days or cyclically and the protocol meets low risk criteria) • Patient has a central venous access device with adequate and reliable venous access • Standard infusions of under 4-h duration • Low complexity of supportive care drugs and/or fluid requirements relating to the protocol • 5FU is the most common drug though several others are also delivered at home • Patient has not had an allergic or anaphylactic reaction during any previous chemotherapy course
Hospital Proximity & Home Environment	Informal caregiver, basic necessities, psychosocial environment, close proximity to a hospital	<ul style="list-style-type: none"> • Informal caregiver who will be present during treatment • Hot and cold running water, electricity, indoor toilet, fridge, working telephone and space for technical equipment • No small children or pets • Adequate psychosocial environment (i.e. patient is not isolated and is not themselves a caregiver) • Hospital within 30-min drive or 1-h drive, or within 20–30 km radius • A validated emergency procedure is in the patient's home, including emergency contacts and telephone numbers • Patient characteristics and home environment do not pose a threat to patient or staff safety

note that the patient/family still incur travel and related costs when using community nursing clinics, whereas home-based chemotherapy models shift such costs to the healthcare system.

5. Limited options for drugs that can be delivered in the home

The only drug currently used for home chemotherapy infusion in Ontario is 5FU. Reasons for this include concerns regarding safety and the stability of other drugs, as well as methods of funding for drugs and for home care. Expanding the regimen of drugs may improve the cost-effectiveness of chemotherapy at

home. Over 80% of CHIPP patients receive short-term infusions of 46 h or less, meaning that they receive only one home visit per course (for a disconnect). Given the cost of supplies, the pump and care coordination, it may be more reasonable to conduct home-based chemotherapy for patients with longer infusion times who require multiple home nursing visits per treatment course.

Challenges specific to the TC LHIN include:

1. A lack of a standardised referral process to the CCAC

Table 5. Patient views and experiences of home-based chemotherapy

Patient-reported advantages of chemotherapy at home	Patient-reported concerns about chemotherapy at home
<ul style="list-style-type: none"> • Communication, availability, and personalised care by nurses in the home • More active treatment role for patient, increasing sense of control and independence • Fewer transport difficulties and travel expenses • More involvement of family members in patient's treatment • Less disruption to daily and family life • Reduced treatment-related anxiety • Fewer financial concerns • Reduced waiting time • Fewer side effects • Familiar environment • Privacy 	<ul style="list-style-type: none"> • Fear of the pump malfunctioning or adverse event at home • Lack of hospital staff and supervision • Commitment of (unpaid) time to patient treatment and supervision by informal caregiver • Adjusting to wearing the portable pump, including potential restriction in daily activities or hobbies and sports • Decreased opportunity to share experience with other cancer patients in the hospital setting • No 'escape' from the illness/treatment

Table 6. Chemotherapy drugs offered in patients' homes

Drug/regimen	Jurisdiction/system							
	Edmonton, AB	British Columbia	NHS, UK	Ireland, UK	Univ. of Michigan, USA	Cleveland Clinic, USA	Victoria, Australia	Literature (<i>n</i> = 54)
5-Fluorouracil (5FU)	X	X	X	X	X	X	X	X
Anthracycline			X		X			X
Bevacizumab							X	
Bleomycin								X
Carboplatin								X
Cisplatin								X
Cyclophosphamide	X		X					X
Cytarabine					X			X
Cytosine Arabinoside								X
Dactinomycin								X
Doxifluridine								X
Etoposide	X						X	X
Gemcitabine	X		X					X
Ifosfamide								X
Irinotecan	X		X					X
Methotrexate	X		X					X
Mitoxantrone								X
Oxaliplatin								X
Pemetrexed								X
Raltitxed	X							X
Trastuzumab	X		X					X
Vinca Alkaloids	X		X					X

Unlike CHIPP, TC lacks a standardised referral process. This makes determining appropriate home care services and scheduling home visits difficult since key information needed to make these decisions and ensure patient safety may not be included in the referral.

2. Last-minute scheduling

Within TC, same day referrals generally result in last-minute scheduling, particularly if patients are not from the TC LHIN. Patients often call the nursing agency before information is received from the CCAC, resulting in a broken chain of communica-

tion; the delay in receiving the referral is thus problematic for the agencies as well as the patients. In addition, supplies are sometimes not delivered in time for a last-minute call, meaning that nurses are unable to complete their visit.

3. Minimal data collection

In existing databases, patients receiving home-based chemotherapy are not coded differently than patients receiving care in other settings, so it is difficult to track volumes. Poor data availability and data quality hinder evaluation of programme effectiveness and identification of areas for improvement.

Table 7. Programme features: CHIPP and the TC LHIN

	CHIPP (Champlain LHIN)	Toronto Central (TC) LHIN
Programme pathway	<ul style="list-style-type: none"> Established programme with a documented pathway and protocol All treatment centres follow the same protocol 	<ul style="list-style-type: none"> No established or documented pathway Various hospitals use different protocols and processes
Treatment facilities	<ul style="list-style-type: none"> Programme centralised at The Ottawa Hospital (TOH), where cancer centre is located Hub and spoke model; TOH houses chemotherapy clinics, however smaller centres in Champlain deliver chemotherapy treatment 	<ul style="list-style-type: none"> Multiple treatment facilities within the TC LHIN; two distinct cancer centres and seven hospitals All hospitals operate independently of each other
Referral process	<ul style="list-style-type: none"> Standardised referral form and process used by providers in the Champlain LHIN for CCAC home services 	<ul style="list-style-type: none"> Referral methods and forms to the CCAC vary by hospital
Patient scheduling	<ul style="list-style-type: none"> Patients scheduled in advance for eight home visits at a time. CCAC receives orders for three to four treatment courses at once. Changes made only when patients are too ill to receive treatment, or physician makes adjustments to treatment schedule 	<ul style="list-style-type: none"> Scheduling method dependent on the hospital The majority of hospitals operate on a 'just-in-time' basis; referrals are made day of or for next day services (exceptions include SMH and Sunnybrook Hospital)

CHIPP, Chemotherapy Home Infusion Pump Program; LHIN, Local Health Integration Networks; CCAC, Champlain Community Care Access Centre; SMH, St. Michael's Hospital.

RECOMMENDATIONS

Based on the results of this multi-pronged study, 14 recommendations are proposed for improving the delivery of chemotherapy in patients' homes. The recommendations are organised below into one of the four themes: patient-centredness, provider training and teamwork, safety and quality of care, and programme management.

Theme 1: Patient-Centredness

Recommendation 1: Consider patient choice of chemotherapy delivery setting

Many patients prefer home care, but some may not. It is important to identify which patients and families are comfortable with chemotherapy at home, and consider the proportion of the population that is willing to receive this level of care at home. Equipment malfunctions and complications are a major concern. Furthermore, some patients prefer to share their experience with other cancer patients in a hospital setting. Patient and caregiver understanding of home-based chemotherapy and their consent to this mode of delivery is paramount.

Recommendation 2: Standardise education/training for patients and informal caregivers

Educational materials and training sessions ensure that patients and their informal caregivers have the minimum knowledge and skills necessary to carry out treatment and respond to potential complications. Thorough coverage of infusion pump guidelines and safety precautions and procedures enhances the confidence and comfort of patients and their caregivers with home-based chemotherapy. In addition to improving the patient experience, standardised education and training may also mitigate adverse events and reduce non-scheduled provider visits or visits to the ED that result from a lack of patient or caregiver knowledge.

Theme 2: Provider training and teamwork

Recommendation 3: Standardise education/training for care providers

Specialised provider education and training are required to safely and effectively deliver home-based chemotherapy. Key topics include risk assessment of the delivery environment, personal safety, infusion pump programming

and troubleshooting, and chemotherapy transportation, handling, administration and disposal, in addition to content related to symptom management and psychosocial supports for the patient and family. Provider training serves multiple purposes including increasing provider confidence and skill, enhancing quality of care, and reducing preventable ED visits and hospital admissions.

Recommendation 4: Formalise team composition and roles and responsibilities

Given the complexity of chemotherapy treatments and the transitions involved in coordinating home-based delivery, an interdisciplinary team-based approach to care is important. The accountabilities of those involved at each stage in the care process must be clearly defined, including identification of person(s) ultimately responsible for the patient's care at home.

Theme 3: Safety and quality of care

Recommendation 5: Standardise patient eligibility criteria

Clear and strict patient eligibility criteria are required in the following areas to maintain patient and provider safety: (1) patient and caregiver readiness, (2) diagnosis, (3) patient characteristics and co-morbidities, (4) treatment regimen and patient's previous response to treatment and (5) hospital proximity and the home environment.

Recommendation 6: Always initiate the first infusion of high risk drugs or regimens in hospital

If the chemotherapy drug or drug regimen meets 'high risk' criteria, the patient's first infusion should always be initiated in a hospital as standard operating procedure. This provides an opportunity to ensure that patients do not have an allergic or anaphylactic reaction, and to offer educational resources and training to patients and their caregivers.

Recommendation 7: Select highly trained and highly experienced nurses to deliver chemotherapy in patient homes

Ensuring that nurses have the appropriate training, clinical skills and clinical judgment, as well as experience in systemic treatment, will help to maintain quality and safe care standards and prevent medical errors. Highly trained and experienced nurses are also best equipped to manage unexpected circumstances that may arise in patient homes.

Recommendation 8: Standardise the referral process

Referral of a patient for chemotherapy at home involves the transfer of information among multiple organisations and providers. A standardised process limits variation across incoming referrals. A standard referral form ensures consistent information is provided for every patient and that key information regarding patient health status or treatment plan is not missing. Ideally, the most effective mechanism for information is access to an electronic patient record. In addition to enhancing safety and quality of care, a standardised, electronic referral process reduces time spent contacting hospitals, physicians and clinics to verify or obtain information.

Recommendation 9: Develop a standardised care pathway

In a care pathway, different tasks or interventions by the providers involved in patient care are defined, optimised and sequenced to reduce variability and ensure evidence-based practice. The pathway helps to clarify care goals and the care plan, as well as provider responsibilities and interactions, thereby reducing the potential for waste and errors in the process. For example, home-based chemotherapy may be delivered by nurses from a hospital, public health agency or home care agency. Although the medical team retains oversight and accountability for patient assessment and care, whether the attending nurse originates from the hospital or a third party provider can influence communication mechanisms, treatment protocols and costs. Care pathways can help clarify and standardise procedures within and potentially across these various models of care to ensure safety and quality of care. Care pathways also serve as a prompt for both providers and patients to discuss the care plan at frequent intervals. The pathway is typically not prescriptive and allows for customisation based on individual patient needs and preferences. A standardised pathway for patients receiving home-based chemotherapy must reflect formal processes for guiding the transition from hospital to home, and vice versa if needed.

Recommendation 10: Tailor protocols and safety systems to the home setting

To maintain patient and provider safety, standard protocols and guidelines for chemotherapy delivery must be tailored to the home setting. This includes processes related to risk assessment and transportation, handling, administration and disposal of chemotherapy. In addition, verification/checking systems must be in place (e.g. for medication reconciliation) as well as an emergency man-

agement plan for responding to and tracking adverse events and other incidents.

Theme 4: Programme management

Recommendation 11: Standardise supplies and equipment for home care

Regional standardisation of infusion pump type and brand for home-based chemotherapy ensures that providers have the skill and experience to work with the pump. This may reduce the incidence of adverse events and avoidable hospital visits. In addition, standardisation of equipment may lead to improved purchasing power and cost savings across providers.

Recommendation 12: Schedule patients in advance for their treatment courses

Advanced scheduling of patients for their treatment courses offers multiple benefits. It enables home care providers to schedule their nurses in advance and prioritise the patient experience of a continuous relationship with an identified healthcare professional. Scheduling multiple visits in advance also decreases the time and costs spent on coordination and communication across providers and with patients. For community pharmacies contracted to provide infusion drugs and equipment, same day referrals result in rushed orders which contribute to inefficiencies and potential errors. Advanced scheduling allows for batch orders of equipment from manufacturers, batch production of drugs and adequate time to methodically prepare for each treatment course.

Recommendation 13: Appoint a nurse coordinator to liaise between different organisations and providers

Nurse programme coordinators serve an important role in home-based chemotherapy programmes. Their responsibilities typically include ensuring proper patient training, referral practices and emergency response procedures, and supporting continuity and coordination of care by maintaining contact with and following the patient over the course of the prescribed therapy and communicating with all providers.

Recommendation 14: Improve data collection methods to assess performance

The availability, quality and accuracy of data on home-based chemotherapy programmes are often weak. A lack of infor-

mation, or unreliable information, on costs, volumes, wait times, adverse events, clinical outcomes, quality of life and satisfaction prevents the identification of gaps and opportunities for improvement.

CONCLUSION

The combined use of an academic literature review, a jurisdictional programme review and comparison, and local case studies allowed for a progressively deeper 'dive' into current knowledge and evidence on home-based chemotherapy. In this paper, we consolidate information on home-based chemotherapy programmes including services and drugs offered, patient eligibility criteria, patient views and experiences, delivery structures and processes, and common challenges. We also outline 14 programme recommendations focused on patient-centredness, provider training and teamwork, safety and quality of care, and programme management. In general, the results support the provision of home-based chemotherapy as a safe and patient-centred alternative to hospital- and outpatient-based service. However, ongoing research is required, particularly in regard to the cost-effectiveness of home-based chemotherapy delivery and best practices for clinical and administrative management.

The study has limitations. First, the literature search focused only on adult populations receiving intravenous chemotherapy. Additional insights and best practices may be identified in the broader literature on home-based chemotherapy which includes paediatric populations and oral, intramuscular or subcutaneous chemotherapy. Second, the jurisdictional scan was not comprehensive and exhaustive; it was limited in scope with the aim of identifying several representative programmes in different contexts. A full jurisdictional scan and review would allow for additional comparison of programme structures, processes and outcomes. Finally, the case studies were focused on understanding how the programmes function from the perspective of the administrators and providers, and utilised document review and staff interviews only. More in-depth case studies incorporating the patient perspective as well as methods such as observation, may have revealed additional findings. These limitations represent opportunities for future research.

As the incidence and prevalence of cancer continues to grow, and as policy changes and the fiscal environment push more services from the hospital into the community, home-based chemotherapy programmes may see a significant increase in demand and volumes over the next decade. The imminent growth of this service offers the opportunity to enhance patient choice of where to receive

care and to build capacity in hospitals and outpatient units; it also raises significant challenges related to patient and provider safety, care coordination and costs. The results of this study can be used by clinical and administrative leaders as well as policy-makers to inform the development of evidence-informed models and policies for the delivery of chemotherapy (and related care) in patients' homes.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

File S1. CHIPP High Level Map.

File S2. TC CCAC Outpatient Map.

APPENDIX A

JURISDICTIONAL SCAN INTERVIEW QUESTIONS:

BACKGROUND

1. When did the pilot/programme start?
2. What was the driver for development of the programme?

PROGRAMME SIZE, STRUCTURE & DELIVERY

1. How many chemotherapy patients do you serve per month?
2. What types of chemotherapy drugs and regimens are offered at home?
3. Do nurses stay in the home for the duration of infusion?
4. Where does the chemotherapy come from?
5. What are the patient eligibility criteria? Is there a home assessment? Are there certain types of patients that are most common because of eligibility criteria or because of preference?
6. Do you provide patient/caregiver training and education? On what? What is the role/responsibility of patients and caregivers?
7. Describe the process from referral to first infusion.
8. Do the nurses provide other services in the home to cancer patients, such as symptom management?

PATIENT SAFETY, COORDINATION & QUALITY OF CARE

1. What kind of background and training do the infusion nurses have?
2. Are there standards and best practices in place that are specific to the home setting?
3. Describe the quality and safety measures that are taken. Do you use verification checks, electronic tools, standardised forms and error reporting systems?

4. Describe coordination of care with primary care physician and specialists.
5. Have there been any adverse events or complications?

PERFORMANCE MEASUREMENT

1. What performance indicators are used to monitor the programme? How is the pilot/programme evaluated?
2. Do you measure patient/family satisfaction? If so, please describe your results.
3. Do you measure provider satisfaction? If so, please describe your results.
4. Describe the provider response to your programme.
5. Have you compared the cost of providing chemotherapy in an outpatient setting versus at home? If yes, what were the results?

PROGRAMME REFLECTIONS

1. What are some of the challenges you have faced?
2. What are some of your success factors?
3. Are there any documents you would be willing to share with us that will give us further insight into your programme?

APPENDIX B

CASE STUDY INTERVIEW QUESTIONS : ROLE WITHIN THE PROGRAMME

1. What is your primary role in the programme?
2. Describe the main tasks that you carry out.
3. In what setting(s) do you interact with the patient?
4. How frequently do you see the patient?
5. What types of interactions do you have with the patient?
6. Which providers do you communicate or work with?
7. How frequently do you communicate with or see them?
8. What methods of communication do you use?
9. Do you ever communicate with the patient's family doctor?

**PROGRAMME STRUCTURE:
ORGANISATIONAL PERSPECTIVE**

1. What are the most important components of the programme?
2. Which organisations are involved in the programme?
3. What are the primary responsibilities of these organisations?
4. Which providers or staff members are involved in the programme? What are their roles?
5. How do these organisations and individuals communicate with one another?
6. How frequently do they communicate?
7. Are there standards for communication in place?

**PROGRAMME STRUCTURE: PATIENT/
PROVIDER PERSPECTIVE**

1. What are the primary requirements for patient eligibility?
2. Are there any assessments conducted of the patient's home environment?
3. Describe the patient pathway within the programme from your perspective.

TOOLS

1. What are the primary tools that you use? Patient-centred tools? Business process tools?
2. For what purposes do you use the above mentioned tools?

3. Do you use any symptom assessment tools? Is this information shared with any other providers?
4. Which other providers do you share these tools with, if any?

**URGENT CARE, INCIDENT REPORTING AND
SAFETY**

1. Is there a process in place for urgent medical issues that arise during home treatment? Where does the patient get referred to?
2. Who is the first point of contact/primary caregiver who is accountable for the patient's safety and well-being while they are at home?
3. Is there a process in place for incident reporting?
4. Are there any triggers that would result in halting chemotherapy at home?
5. Are there any safety points within the drug delivery process? Who is accountable for these safety checks?

PROGRAMME OUTCOMES AND MEASURES

1. What are the primary benefits of the programme? Hospital perspective? Patient perspective? Medical (oncologist) perspective?
2. Are there any measurement or data collection points?
3. Describe the performance of the programme. Is this based on anecdotal evidence or data?