Polypharmacy: Institutional Approaches to Support Patients, Systems and the Climate

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Abstract

As polypharmacy continues to rise in Canada, its impact on patient care and healthcare systems becomes more significant. This article explores the consequences of polypharmacy, including increased patient risks, environmental footprint, financial strain and added workload for staff. It also highlights effective strategies for mitigating polypharmacy, such as deprescribing, non-pharmacological interventions, medication stewardship programs and mandatory medication review or stop dates. By adopting these approaches, healthcare institutions can reduce polypharmacy, improve patient outcomes, optimize staff efficiency, reduce medication costs and lessen their environmental impact.

Introduction

Polypharmacy, most commonly defined as five or more concurrent medications, is increasingly recognized as a substantial contributor to medication-related harm across the globe. In 2021, 62% of older adults were taking five or more prescription medications, with 25% taking 10 or more medications from 10 unique drug classes (CIHI 2022).

This article discusses how institution leaders and administrators can address polypharmacy in an economical, workload-efficient and environmentally conscious manner while supporting safe, effective and evidence-based patient care.

Although medications are prescribed with the intent to benefit patients, the cumulative impact of polypharmacy can have several negative consequences. Over the past decade, research has highlighted the association between polypharmacy and a range of adverse patient outcomes, including functional decline, cognitive impairment, falls, malnutrition, urinary incontinence, drug interactions, adverse drug events (ADEs) and medication non-adherence (Maher et al. 2014). Patients experiencing polypharmacy are often prescribed one or more potentially inappropriate medications (PIMs) and/or experience ADEs from one or several of their medications (Faustino et al. 2011; Laroche et al. 2007). In 2021, PIMs were estimated to result in a direct cost of $1 billion to the Canadian healthcare system (Huon et al. 2024).

From an institutional perspective, medication use impacts financial and labour resources. Every medication delivered to a patient within an institution comes with a significant workload, as multiple steps and people are required to fulfill this process (Figure 1). Therefore, as polypharmacy rises within the Canadian population, the workload associated with drug distribution continues to grow, requiring increased financial investment in resources and staffing to address this emerging demand.

In addition to patient care, financial and workload consequences, medications have a substantial environmental impact. The journey of medications to hospitals involves multiple stages, beginning with the global sourcing of active pharmaceutical ingredients and excipients, followed by manufacturing, shipping, consumer purchasing and delivery to Canadian hospitals (Kaur et al. 2025). In fact, medications are responsible for approximately 8 million tons of carbon dioxide equivalents, representing a quarter of all greenhouse gas emissions within the healthcare sector in Canada (Eckelman et al. 2018).

FIGURE 1.
An overview of a medication's lifespan, highlighting the processes and resources involved in administering medications in an institution and the consequent waste produced

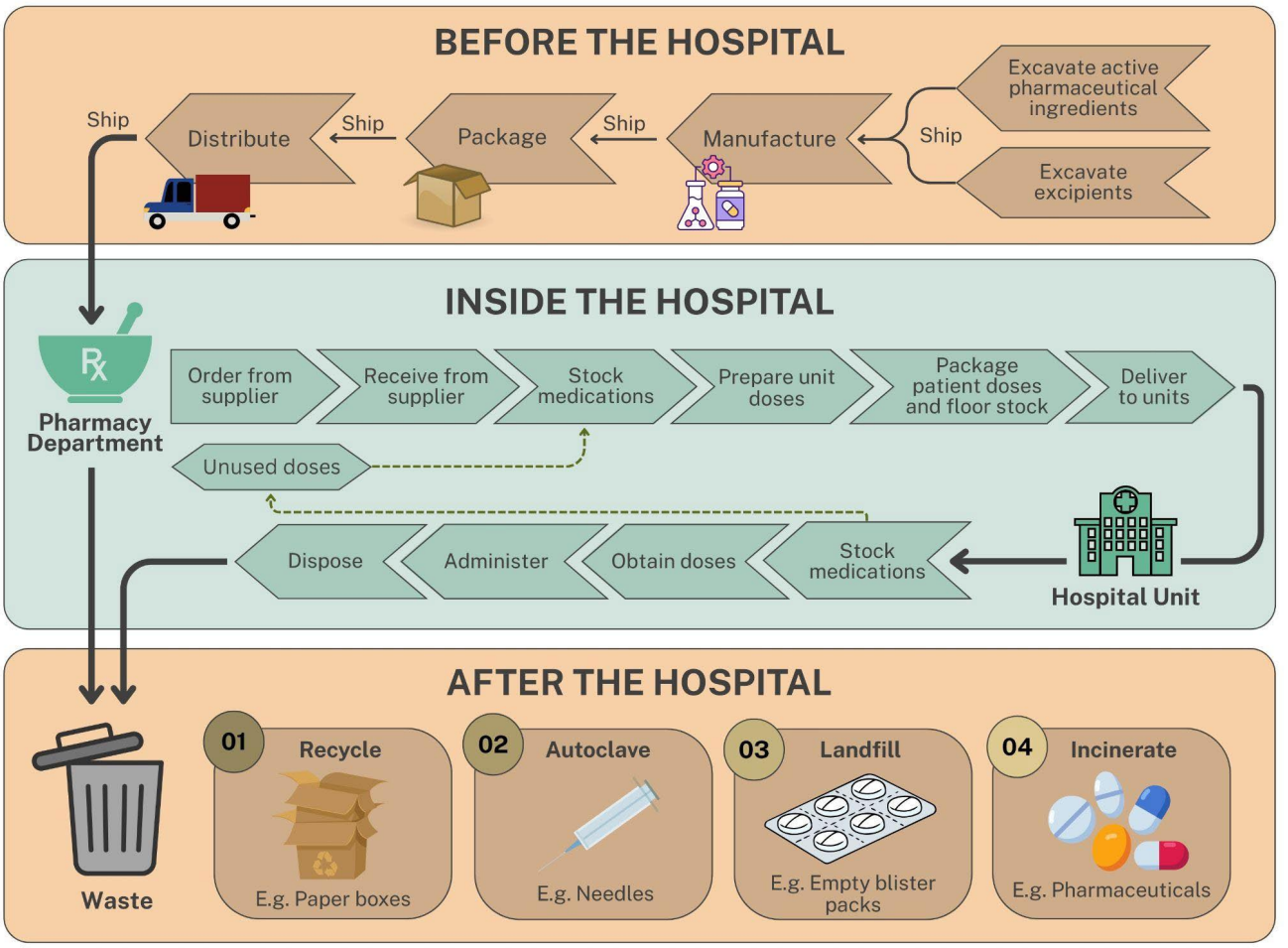

Figure conceived by Ivy Lam, with contributions from the author team and final design by Thirumagal Gowrikanthan and Vasuki Kirubhakaran.

Once the medications are delivered to hospitals, many solid-dose medications require single-use unit-dose plastic packaging that is thrown out immediately after medication administration. Administered medications are then excreted into our water system, potentially impacting local ecosystems and non-target organisms (Winker et al. 2008). By-products of medication administration, such as large quantities of single-use paper, labels, syringes, needles, gloves, administration cups, masks and gowns, are often disposed of in landfills or incineration sites. Unused medications are typically sent for high-temperature incineration, another process with known negative impacts on the environment and human health (Government of Canada 2010).

Changing the manufacturing process is beyond the scope of this article. However, reducing medications and polypharmacy will reduce this environmental impact. It is estimated that a 5% reduction in drug consumption at a hospital with 200 beds could cut more than 100 tonnes of greenhouse gas emissions annually, equivalent to approximately 4,000 car trips of 100-kilometre (Sergeant et al. 2022). Reducing medication use is also beneficial for its impact on staffing workload and medication budget. Institutional leaders and administrators can explore a range of medication reduction strategies that not only align with their clinical and environmental goals but also balance their financial considerations (Table 1).

Deprescribing

One solution to polypharmacy that has garnered significant attention over the last decade is deprescribing. Deprescribing is commonly defined as the process of discontinuing an inappropriate medication under the supervision of a healthcare professional, aiming to enhance patient outcomes and reduce

TABLE 1.
A summary of strategies to reduce medication use and each intervention's estimated cost and benefits

	Estimated cost to implement	Estimated reduction of medication use	Estimated environmental benefit
Clinician deprescribing	Low	Moderate	Moderate
Electronic decision support tools	Moderate	High	High
Deprescribing with AI information-gathering support	High	High	Low
Non-pharmacological strategies	Low to high*	Low to high*	Low to high*
Medicine stewardship programs	Moderate to high	High	High
Medication stop or review dates	Low	Low to moderate	Low to moderate

*Depends on the non-pharmacological strategy being implemented. AI = artificial intelligence.

polypharmacy (Reeve et al. 2015). In addition, some definitions include reducing the dose of a medication and switching to alternative, more appropriate medication (Reeve et al. 2015). Regardless of which deprescribing plan is pursued, the goal remains the same: improving patient outcomes while reducing medications or total daily doses administered.

From a patient care perspective, it has been found that appropriate deprescribing can reduce polypharmacy and potential consequences while being unlikely to cause harm to the patient (Reeve et al. 2015). For institutions, deprescribing can have a positive impact on their finances and environmental footprint due to the reduction of medications being ordered, delivered, dispensed, administered and monitored. Ideally, all institutional clinicians would implement deprescribing in their daily practice. Institutional management and decision makers can support clinicians through continued education and providing resources to facilitate the implementation of new evidence-based guidelines on deprescribing, appropriate medication indications and treatment durations (Box 1).

Another way institutional management can promote appropriate deprescribing in their institutions is through the use of electronic deprescribing decision support tools, such as MedSafer, MedStopper and TaperMD. MedSafer is a deprescribing tool that an institution can purchase to assist clinicians in deprescribing by identifying PIMs and generating a list of deprescribing opportunities in acute and long-term care settings (MedSafer: Working Towards Safer Prescribing n.d.). MedStopper is a free web tool that assesses the benefits of continued treatment, lists the potential harms of each medication and then organizes these medications into deprescribing priority levels (MedStopper n.d.). Lastly, TaperMD is a clinical tool that offers two-way integration into long-term care electronic medical records (EMRs), such as PointClickCare, and provides recommendations and monitoring suggestions using data received from the EMR profile (TaperMD n.d.). All of these tools are intended to aid clinicians in their treatment plans and deprescribing, and are not a substitute for individual clinician decision making.

Alternatively, institutions may integrate their own clinical decision support (CDS) tools into existing EMRs and computerized provider order entry (CPOE) systems. The goal of these CDS tools is to provide healthcare professionals with clinical recommendations during order entry. The incorporation of different CDS tools, including soft, hard and passive alerts, has been studied, with one systematic review suggesting that the implementation of hard-stop alerts showed improvement in lab, imaging and/or prescribing rates (Powers et al. 2018). To mitigate alert fatigue and prevent care delays associated with CDS tools, institutions can offer clinicians the ability to opt in or out of their CDS alerts, based on their prescribing practices, deprescribing knowledge and workflow (Powers et al. 2018).

One barrier that clinicians identify for deprescribing is the time required to complete the deprescribing process, including reviewing a patient's profile and gathering essential medication

BOX 1.
A list of deprescribing and medication optimization resources clinicians can reference while creating care plans for their patients

Deprescribing and medication optimization resources

- **Deprescribing.org** (deprescribing.org)
- **The Canadian Medication Appropriateness and Deprescribing Network** (CADeN) (https://www.deprescribingnetwork.ca/)
- **Choosing Wisely Canada** (choosingwiselycanada.org)
- **American Geriatrics Society's Beers Criteria** (J Am Geriatr Soc. 2023 Jul; 71(7): 2052–2081. doi: 10.1111/jgs.18372. Epub 2023 May 4)
- **Screening Tool for Older People's Prescriptions** (STOPP) and **Screening Tool to Alert to Right Treatment** (START) Criteria (Eur Geriatr Med. 2023 May 31;14(4): 625–632. doi: 10.1007/s41999-023-00777-y)
- **SwitchRx** (https://www.switchrx.com/)

assessment information from various sources (Thompson and McDonald 2024). This patient history and data help clinicians determine whether deprescribing is both appropriate and safe. With the ongoing integration of artificial intelligence (AI) in healthcare, AI has the potential to streamline this process. By screening patient profiles and extracting relevant medical histories, AI is poised to reduce the time burden associated with data collection for clinicians, enabling them to conduct more deprescribing assessments or allocate time to other patient care tasks.

AI is also being explored as an integrated CDS for deprescribing; however, the current literature for this use is limited and conflicting. In the coming years, it is expected that new studies will assess the effectiveness of AI as both an information-gathering tool and a CDS system. These findings will be instrumental in shaping the integration of AI into institutional practice, ultimately guiding its role in the deprescribing process.

Optimizing Non-Pharmacological Strategies

Many healthcare providers recognize that non-pharmacological strategies are the preferred management intervention for various diseases and conditions. Examples include weight loss and exercise for mild hypertension or type 2 diabetes and music therapy for behavioural and psychological symptoms of dementia. However, in institutional settings, the implementation of these strategies is not always clinically appropriate or logistically feasible. For patient care reasons, it may be more suitable to initiate pharmacotherapy rather than non-pharmacological interventions for medical conditions related to the patient's admission and acuity level. Nevertheless, it is advisable to consider the application of these strategies for non-acute conditions or as an adjunct to pharmacotherapy.

In many ways, institutions already have non-pharmacological strategies in place by providing physiotherapy sessions, social work counselling and/or a variety of disease-targeted diets. However, institutions can further enhance their efforts by identifying and implementing new non-pharmacological strategies aimed at reducing polypharmacy.

Insomnia is prevalent among hospitalized patients, with studies reporting 47–67% of patients having poor sleep and an average reduction of 90 minutes in sleep compared to home (Dobing et al. 2016; Meissner et al. 1998; Talih et al. 2018). It is not surprising, then, that many patients are initiated on sleep-inducing medications during their hospital admission, with some patients continuing these medications after discharge (Bourcier et al. 2018; Heinemann et al. 2019). Sedative use in adults over the age of 65 years have been found to be particularly harmful, increasing the risk of dependence, cognitive and psychomotor impairment and falls (Kripke 2000; Leipzig et al. 1999; Weymann et al. 2017). Ecologically, sedative residues can be found in excretion after use and have been linked to behavioral, developmental and reproductive abnormalities impacting non-target aquatic organisms (Moreira et al. 2022; Zhu et al. 2023). Efforts should be made to minimize the initiation of sedatives in hospital settings by prioritizing non-pharmacological interventions. Sleep hygiene protocols, which involve white noise machines, earplugs, eye masks, reduced lighting for patients or adjusting standard medication administration times to reduce sleep disturbances, can be introduced. While many of these strategies have one-time or recurrent costs associated with them, they promote effective disease management while also reducing polypharmacy and institutional medication use.

Medication Stewardship Programs

Medication stewardship programs involve interdisciplinary teams that use systematic approaches and evidence-based guidelines to improve the appropriate use of specific medication classes within an institution or practice setting (Su et al. 2023). Medication stewardship programs can reduce polypharmacy with the deprescribing of inappropriately prescribed medications. These individual, patient-specific medication discontinuations can have a great impact when the cumulative effect of all these unused doses is considered. Each medication ordered, packaged and administered in an institution has a workload, financial and environmental cost associated with its use. Appropriate medication deprescribing can consequently result in net savings in all of these domains.

Antimicrobial stewardship programs are the most prevalent medicine stewardship program within Canada after becoming an Accreditation Canada Required Organizational Practice in 2013 (Antimicrobial Stewardship n.d.). Antimicrobial stewardship programs have been found to reduce antimicrobial use, decrease antimicrobial resistance, reduce institutional expenditure on antimicrobial drugs and improve patient outcomes (Maximos 2021; Timbrook et al. 2016). In the US, it was estimated that the annual net cost-savings of an antimicrobial stewardship program was $920,000 to $2,000,000 USD for an 880-bed medical centre in the early 2000s and $1,877,956 USD for a 700-bed academic medical centre between 2009 and 2013 (Beardsley et al. 2012; Timbrook et al. 2016).

Despite the success of antimicrobial stewardship programs nationally over the past 20 years, there are comparatively fewer medication stewardship programs focusing on appropriate use for other medication classes (Dyar et al. 2017). Institutional leaders and decision makers should explore other medication stewardship programs and identify opportunities for initiatives that target other high-risk medications such as anticoagulants, opioids or psychotropics.

St. Paul's Hospital is the first institution in Canada to establish an Anticoagulation Stewardship Program (ACSP) using an audit and feedback strategy focused on reducing the inappropriate use of anticoagulation medications (Providence Health Care 2024; Wan et al. 2024). Their team identified

additional co-benefits of improved patient outcomes, reduced medication costs, reduced environmental impact associated with heparin use and reduced nursing workload (Providence Health Care 2024). From a cost-savings perspective, the team reported over 1,300 nursing hours and $75,000 saved from reduced heparin prescribing, which exceeded half of the costs of the ACSP pharmacist's salary (Providence Health Care 2024; Wan et al. 2024).

Additional innovative stewardship programs that institutional management may consider include an opioid stewardship program or psychotropic stewardship program (Su et al. 2023). Acute and chronic opioid use has been associated with tolerance, dependence, addiction, overdose and/or death (Benyamin et al. 2008). Antipsychotic medications also have significant harms, including an increased risk of mortality, cardiovascular and cerebrovascular incidents, extrapyramidal symptoms, falls, edema, urinary tract infections, weight gain and diabetes (Bjerre et al. 2018). Opioids and antipsychotics have also been detected in treated wastewater and surface water as these excreted drugs are not completely removed during the wastewater treatment process, exposing aquatic wildlife to psychoactive chemicals (Bossé and Peterson 2017; Campos-Mañas et al. 2018; Escudero et al. 2021; Wronski and Brooks 2023; Zhang et al. 2022). Given these risks, opioid and psychotropic stewardship programs have the opportunity to ensure these medication classes are appropriately prescribed during the institutional stay and at discharge, improving patient outcomes and successful treatment in the community.

Medication Stop or Review Dates

Implementing mandatory stop dates for certain medications is another method to reduce unnecessary medication use in institutional settings. This approach requires prescribers to specify an end date before submitting a medication order. Stop date policies aim to prevent unnecessarily extended durations of treatment for acute medical conditions and encourage healthcare providers to consider treatment durations at the time of prescribing. Stop dates may also serve as a communication tool, informing the care team about treatment plans. Medication classes that may benefit from mandatory stop dates include antibiotics, opioids, sedatives, hypnotics and anticoagulants for deep vein thrombosis (DVT) prophylaxis or treatment. In the event that one of these medications is intended for long-term use, such as chronic suppressive antibiotic therapy, prescribers will still enter an end date, but one that is several years in the future to prevent the medication from being unintentionally discontinued during admission.

It is vital for institutional management and healthcare providers to recognize the distinction between automatic stop dates/orders and mandatory stop dates/orders. An automatic stop order is a policy that has a pre-selected treatment duration for a specified medication or medication class that is automatically applied to an order when an end date is not specified at the time of prescribing. These types of stop dates have fallen out of favour over the years due to conflicting evidence on the improvement in treatment, cost, readmission rates, length of stay and patient outcomes (Cowart et al. 2022; Do et al. 2012; Ross et al. 2016).

Alternatively, if an institution is not suited to implement a mandatory stop date policy, it can implement mandatory medication review dates. This approach would require healthcare providers to re-evaluate the indication, efficacy, safety and duration of treatment after a specified period of time has elapsed with the same objectives of reducing overtreatment or prolonged medication therapy for acute conditions. An example of this application would be establishing a 30-day review date for anticoagulation therapy in patients receiving DVT prophylaxis with heparin on specific units, at which point clinicians would assess the patient's risk factors for DVT in relation to the risk of bleeding.

Regardless of whether an institution enforces mandatory stop or review dates, these policies serve as a strategic approach to mitigate polypharmacy by preventing prolonged use or extended durations of medications prescribed for acute conditions with a well-defined evidence-based treatment course.

Conclusion

While medications remain an essential component of disease treatment and prevention in healthcare, mounting evidence highlights the possible negative effects of polypharmacy on patient well-being. The consequences of polypharmacy are even more profound after considering medication's role in driving climate change, straining finances and overwhelming staffing workloads.

In this article, we suggest deprescribing, optimizing non-pharmacological therapies, creating targeted medication stewardship teams and incorporating mandatory stop or review dates as potential initiatives to achieve this goal. As healthcare institutions strive to provide an exceptional level of care in an economic and sustainable manner, it is imperative that management and administrative leaders monitor medication use trends and identify opportunities to promote appropriate medication management. HQ

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