Penn Medicine launched the Cancer Care at Home (CC@H) program in November 2019 to demonstrate that many infused or injected cancer drugs could be delivered safely at home, in addition to hospital or outpatient settings. Successful models for home infusion of cancer drugs exist, and the building blocks were in place at Penn Medicine, but at-home administration of cancer drugs remains uncommon in the United States. The Covid-19 pandemic propelled Penn Medicine to accelerate CC@H with three goals: continue cancer treatment for immunocompromised patients while keeping them out of health care facilities, decrease density in infusion suites, and increase hospital capacity for Covid-19 and other patients. Over a seven-week period in late March and April 2020, CC@H saw a 700% increase in home infusion referrals for patients with cancer, from 39 to 310 patients. Our experience shows that, for appropriate cancer drugs and patient populations, home administration of cancer drugs can replace inpatient or outpatient administration.

Background

The Covid-19 pandemic has prompted rapid changes in global cancer care delivery. In the United States, where an estimated 1.8 million Americans will be diagnosed with cancer in 2020, physicians are making unprecedented decisions about which cancer care to continue and how best to deliver care safely. Emerging evidence suggests that cancer patients are at increased risk of morbidity and mortality from Covid-19. Minimizing the time spent by patients with cancer in health care settings is critical to reducing potential exposure to Covid-19.
Internationally, home administration of cancer drugs has been found to be safe and effective across a range of patient populations and treatment regimens; it is estimated that 5% to 10% of patients globally receive cancer treatments at home.\textsuperscript{8-21} Low-complexity infusions, such as hydration and other supportive treatments, and over 20 intensive chemotherapy regimens have been safely administered at home. Home infusion results in comparable care and improved patient and caregiver experience at lower cost than inpatient or outpatient infusion.\textsuperscript{12,16-22-25} However, in the United States, delivering cancer drugs at home is uncommon. Two challenges strongly favor administration in outpatient infusion suites or hospitals: 1) deeply held biases toward outpatient and inpatient treatment (versus home treatment) among both clinicians and patients; and 2) longstanding health insurance benefit design and cancer drug reimbursement policies.

Penn Medicine, a six-hospital health system in the Philadelphia region, cares for more than 17,000 new cancer patients every year.\textsuperscript{26} As of February 2020, only 670 cancer patients were receiving drug infusions, injections, or other care through Penn Home Infusion Therapy, a service provided by Penn Medicine at Home; these included infusions of 5-fluorouracil chemotherapy, hydration, or medicines for symptom relief. Despite being safe and effective, home infusion was underutilized for cancer patients at Penn.

Our objective for launching Cancer Care at Home (CC@H) — a demonstration program at Penn Medicine to expand home cancer treatment options for patients — was threefold. First, we aimed to demonstrate that home cancer treatment could, for appropriate cancer drugs and patient populations, safely replace inpatient or outpatient care. Second, with the onset of the Covid-19 pandemic, we aimed to scale quickly to keep immunocompromised cancer patients out of health care facilities while continuing their cancer treatment, reducing density in infusion suites and increasing hospital capacity. Third, we aimed to identify changes in health care financing required to support expanding the availability of home treatment after the Covid-19 crisis.

**Demonstrating that Home Cancer Treatment Could Replace Inpatient or Outpatient Care**

**Engaging critical stakeholders**

In November 2019, Penn Medicine’s Penn Center for Cancer Care Innovation, Center for Health Care Innovation, Penn Home Infusion Therapy, and Cancer Service Line began planning CC@H to move more cancer treatment to the home setting via Penn Home Infusion Therapy. We engaged executive sponsors and established a CC@H coordinating team comprised of clinical and operational leaders from across the participating Penn Medicine entities. They were charged with testing how cancer treatments, typically administered in inpatient and outpatient settings at the Hospital of the University of Pennsylvania, Penn Medicine’s largest hospital, could be moved to the home (Figure 1).
Selecting appropriate treatments and patient populations

The CC@H coordinating team evaluated a list of cancer drugs that could be administered at home. We evaluated each drug based on four factors: 1) whether the drug was stable and safe to deliver at home; 2) whether the targeted patient population could safely receive the drug at home; 3) whether there were insurance coverage restrictions or additional costs for patients to receive the drug at home versus in the inpatient or outpatient setting; and 4) whether it would be economically
sustainable for Penn Medicine to administer the drug at home versus in the inpatient or outpatient setting.

We selected two treatments to demonstrate the program’s feasibility at two operational extremes. Both were clinically safe to deliver at home for specific patient populations. The first, leuprolide, is a simple, intramuscular injection for patients with breast and prostate cancer. The injection is usually administered in outpatient settings every one to three months for five to 10 years for breast cancer, and every three to six months over various durations for prostate cancer. The second treatment, dose-adjusted EPOCH, is a complex multi-drug regimen typically delivered in an inpatient setting for treatment of aggressive non-Hodgkin lymphoma. EPOCH includes a 96-hour continuous infusion of combination chemotherapy. Patients typically receive six five-day cycles every 21 days.

Addressing clinician and patient bias

We conducted over 40 semi-structured interviews and contextual observations focused on home administration of leuprolide and EPOCH with patients, family caregivers, and clinicians, including physicians, advanced practitioners, pharmacists, and nurses. Interviews revealed deeply held biases in decision making in which participants favored outpatient or inpatient settings for cancer treatment if they had no previous experience with home treatment. Patients reported concerns about safety and expressed deference to their oncologist’s clinical recommendations, often indicating they would consider cancer care at home only if recommended by their doctor. Physicians reported concerns about safety, an increased burden for the clinical care team for patient triage and management, and an inability to easily order or track the progress of cancer care at home in Penn’s electronic health record (EHR).

“Interviews revealed deeply held biases in decision making in which participants favored outpatient or inpatient settings for cancer treatment if they had no previous experience with home treatment.”

Taken together, these comments were consistent with three principal barriers: 1) status quo bias, in which physicians or patients stick with past experience – in this case, “cancer drugs should be given in the safety of the clinic” – even if good or even better alternatives exist; 2) therapeutic norm bias, in which physicians tailor practice patterns to groups of patients, rather than individuals, missing an opportunity to identify subgroups of patients who could be safely treated at home; and 3) friction costs, in which physicians, even if prone to prescribe home treatment, were deterred from doing so by complicated EHR ordering requirements or other perceived or actual barriers. (Figure 2).27,28
Leveraging Behavioral Economics Principles to Address Clinician and Patient Bias

| Identified bias                                                                 | Underlying behavioral economics principle | Design elements to address barrier                                                        |
|---------------------------------------------------------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------|
| Physicians or patients prefer to stick with past experience                      | Status quo bias: People tend to favor the status quo and current practices rather than initiating change | Introduction of home care as the default option for appropriate treatments and patients |
| Physicians tailor practice patterns to groups of patients, missing opportunity to identify subgroups of patients safe to be treated at home | Therapeutic norm: Physicians tend to choose treatments based on norms for broad classes of patients rather than customizing treatments to individual patients | Process changes to proactively identify patients meeting specific clinical criteria for home treatment |
| Physicians were deterred from ordering home treatments by complicated EHR ordering requirements and potential increased patient management burden | Friction costs: People tend to be deterred from taking action on desirable behaviors by perceived or actual speed bumps | Process changes to simplify ordering and remove other barriers |

Source: The Authors

We applied insights from behavioral economics to design workflows for leuprolide and EPOCH administration at home, systematically addressing biases or sources of friction. To counter status quo bias, we introduced home treatment as the default option for all patients meeting specific clinical criteria. Physicians and patients opted out of home treatment if they preferred to maintain their care in the inpatient or outpatient setting. To address safety concerns, we gave physicians and patients additional information about Penn Home Infusion Therapy services, including home infusion nurse training and Oncology Nursing Society certification. To address therapeutic norm bias with physicians, we proactively identified optimal candidates for home treatment based on specific clinical criteria agreed upon by clinical teams. To minimize friction costs of shifting from inpatient or outpatient to home treatment, we offloaded as much work as possible from the provider. We had clinical and administrative staff call patients, prepare drug orders, schedule visits, document updates in the EHR, and handle calls about medical issues. This approach allowed us to quickly test small changes to reduce sources of friction in the process and understand the resources required to sustain and scale the program.

Assessing payer benefit design and reimbursement policies

While we incorporated design elements in Cancer Care at Home (CC@H) to address clinician and patient bias, we identified additional barriers related to benefit design and reimbursement that were harder to overcome. For leuprolide, while most commercial payers covered home
administration, Medicare part B home infusion benefits did not. Medicare part D plans offered
some coverage for leuprolide injections at home, but often with higher out-of-pocket costs than for
outpatient administration. For EPOCH, reimbursement for the health system was unsurprisingly
lower in the home versus inpatient setting. Because the Hospital of the University of Pennsylvania
is regularly at capacity, moving EPOCH administration from the inpatient to home setting was
seen as a patient-centric imperative to increase bed capacity and create access for new patients.
Hospitals with capacity, on the other hand, could view the lower reimbursement rate as a
disincentive for providing EPOCH treatment at home.

**Demonstrating early success**

We launched CC@H in February 2020. During the first five weeks of implementation, from mid-
February to mid-March 2020, providers referred 39 patients to receive seven cancer drugs at home.
This included leuprolide with or without zoledronic acid or denosumab and dose-adjusted EPOCH.
Patient and provider feedback was largely positive (Figure 3).

**FIGURE 3**

### Examples of Patient and Clinician Feedback

| Patient & caregiver feedback | Clinician feedback |
|-----------------------------|--------------------|
| About leuprolide depot injections: | “What a well-timed project.” |
| “I called [outpatient injections] my calendar-killer. I had to work my life around this shot.” | “This is a ‘just in time’ effort.” |
| “[At the outpatient infusion suite] I have waited as long as 1.5 hours.” | “This could be the new normal.” |
| “I don’t have to take PTO to get my shot [at home]. Now I have more personal time if I were to get sick. [My] employer was happy too.” | “Great potential impact on improving the infusion logjam and patient satisfaction for all patients.” |
| “It was professional and private” | “This is awesome! I was literally just complaining to colleagues about this yesterday (how it’s such a chore to get patient’s monthly or q12 [every 12] week Lupron, trying to arrange for them locally, etc.) so I think this project is awesome.” |
| “Saved me a lot of money, [for outpatient injections, I pay for parking and food every time.” | |

About dose-adjusted EPOCH:

“[Treatment] moved faster than it moved in the hospital. The machine usually stops in the hospital.”

“It’s much more comfortable than being in the hospital. I sleep much better because the machines aren’t beeping. And the backpack is much less bothersome than the [hospital] IV.”

“You need to figure out other treatments to add to this.”

“It’s fabulous having the chance to pioneer what was previously ‘impossible.’”

“The best way to sum up the difference between undergoing R-EPOCH chemo in the hospital and at home is that it transformed [my husband] from being a patient back into a person.”

Source: The Authors

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Scaling Quickly with the Onset of Covid-19

With the rise of Covid-19 cases in March 2020, clinician demand for leuprolide and EPOCH at home increased substantially. The pandemic immediately lowered clinician and patient bias against widespread adoption of cancer treatment at home. Oncologists began proactively reviewing upcoming patient appointments to assess appropriateness for home infusion to ensure continuity of care.

Simultaneously, CC@H executive sponsors from across Penn Medicine provided new staff support that included a Penn Home Infusion Therapy liaison providing concierge communication services for patients and providers, as well as a triage nurse on each of the breast cancer, prostate cancer, and lymphoma clinical teams to coordinate patient referrals for home treatment. We rapidly refined workflows for scale that incorporated these resources. Leuprolide and EPOCH at home became the standard of care for appropriate patients at our hospital. Two additional Penn Medicine hospitals also began to refer patients for leuprolide at home.

We made the process as simple as possible from the patient perspective. Patients discussed CC@H with their provider during a telehealth or in-person visit, and the provider prescribed home treatment in the EHR. Staff from Penn Home Infusion Therapy obtained insurance authorization, discussed out-of-pocket costs with the patient, and scheduled a home visit. (As with inpatient or outpatient treatment, Penn Medicine provides financial counseling and assistance programs to uninsured and underinsured patients who cannot pay for all or part of their care.) A courier delivered the treatment to the patient’s home up to two days before the scheduled visit. A nurse then went to the patient’s home to administer the treatment.

We leveraged learning and buy-in from the CC@H program to inform rapid testing of new candidates for at-home treatment for additional patient populations during Covid-19, prioritizing treatments based on clinical need. These treatments included pembrolizumab for lung cancer and head and neck cancer, rituximab for lymphoma, and bortezomib for multiple myeloma.

From mid-March through late April, providers increased referrals to Penn Home Infusion Therapy from 39 to 310 patients, a 700% increase in the number of patients participating in the CC@H program.

From mid-March through late April, providers increased referrals to Penn Home Infusion Therapy from 39 to 310 patients, a 700% increase in the number of patients participating in the CC@H program (Figure 4). The number of cancer drugs provided at home increased from seven to 13, including the five-drug regimen EPOCH. With input from physicians, pharmacists, and advanced practitioners, we identified 12 additional cancer drugs that would be feasible and safe to administer at home in the near future.
Historically, payers have provided higher reimbursement rates for many infused and injected cancer drugs given in the outpatient versus the home setting. This rate difference presents an opportunity for payers to reduce spending through site-of-care policies that encourage home treatment for certain drugs. At the same time, this reimbursement gap poses an economic barrier for health systems that could lose infusion revenue from expanded home cancer care. During Covid-19, when immunocompromised patients face safety risks and cancer care guidelines recommend deferring treatment in many inpatient or outpatient settings, it can make both clinical and economic sense for health systems to deliver some cancer drugs at home — even if they’re reimbursed at a lower rate — if the alternative is to have patients miss their treatments.
However, we recognize that, both during and after the Covid-19 pandemic, there will undoubtedly be pressure to give cancer drugs that are suitable for home administration instead in inpatient or outpatient settings, particularly as health systems navigate serious financial strain due to the pandemic. As hospitals consider programs like CC@H, economic sustainability will be top of mind. Our experience suggests that the factors guiding decision making will include capacity at sites of care other than the home (inpatient, hospital outpatient, physician office), drug pricing, labor and building costs, and insurer coverage and benefit design. However, home administration of appropriate cancer drugs is patient-centric, safe, and more convenient for patients. It was an important care delivery option before the Covid-19 pandemic, it has directly benefited patients during the pandemic, and will remain an important option after the pandemic.

**Our Recommendations**

To expand availability of home administration of cancer drugs, the Centers for Medicare & Medicaid Services (CMS) and commercial insurers should develop financing policies that incentivize or promote this care model. We suggest two main approaches to support shifting the site of care for certain cancer drugs to the home setting after Covid-19. First, insurers should consider testing new payment models with health care providers to increase incentives for delivering cancer care at home. Alternatives, such as the CMS Oncology Care Model and the second generation Oncology Care First Model, could catalyze cancer care at home by financially incentivizing adoption, sharing savings, and compensating hospitals or physician practices for the investments required to create and maintain cancer-care-at-home programs, likely in partnership with established home infusion providers. Second, insurance benefit design should incentivize, or at least not obstruct, home administration of cancer treatments. Policymakers should consider changes to benefit design so that patients have similar, or even lower, out-of-pocket costs for home infusion versus outpatient infusion.

“To expand availability of home administration of cancer drugs, the Centers for Medicare & Medicaid Services (CMS) and commercial insurers should develop financing policies that incentivize or promote this care model.”

Penn Medicine’s Cancer Care at Home program provided a foundation for rapid care transformation in response to Covid-19. We demonstrated that home cancer treatment can, for appropriate cancer drugs and patient populations, replace inpatient and outpatient administration, keeping immunocompromised cancer patients out of health care facilities while continuing their cancer treatment during the pandemic.

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Acknowledgements

The CC@H program was undertaken as a quality improvement initiative, and as such was not formally reviewed by the University of Pennsylvania’s Institutional Review Board. This work benefited from the contributions of many individuals across Penn Medicine, including from: Penn Medicine at Home: Mary Denno, MSN, RN, Director of Professional Practice, Penn Medicine at Home; Sarah Johnson, MBA, COO, Penn Medicine at Home; and Katherine Major, MSN, RN, CPHN, Director, Penn Home Infusion Therapy; Sandra Jost, PhD, RN, Chief Clinical Officer & Associate Executive Director, Penn Medicine at Home; Cassandra Redmond, PharmD, MBA, Director of Pharmacy, Penn Home Infusion Therapy. Penn Center for Cancer Care Innovation: Alicia Clifton, MDP, Project Manager. Penn Medicine Cancer Service Line: Jenn Braun, MHA, RN, BSN, Director, Quality Improvement & Patient Safety, Cancer Service Line; Pat Higgins, MHA, Senior Director, Service Line and Network Integration, Cancer Service Line; David Miller, MBA, Chief Administrative Officer, Cancer Service Line; Lawrence Shulman, MD, Deputy Director,
Clinical Services, Abramson Cancer Center. Division of Hematology and Oncology, Department of Medicine, Perelman School of Medicine at the University of Pennsylvania: Roger Cohen, MD, Director, Hematology/Oncology Fellowship Program, Associate Director of Clinical Research, ACC; Elizabeth Gilbert, PA-C, Physician Assistant, Medical Oncology; Rebecca Hirsh, MD, Director of Inpatient Oncology Services, Division of Hematology and Oncology; Dan Landsburg, MD, Medical Director of Infusion Services, Hospital of the University of Pennsylvania and Vice Chief of Quality and Safety, Division of Hematology and Oncology; Suzanne McGettigan, MSN CRNP AOCN, Clinical Manager, Division of Hematology and Oncology; David Vaughn, MD, Vice Chief for Clinical Affairs, Division of Hematology and Oncology. University of Pennsylvania Health System: Neil Crimins, Director, Service Line Analytics, Strategic Decision Support; Roy Schwartz, MBA, Vice President, Managed Care; Robert Tobin, System Director, Infusion Services. Hospital of the University of Pennsylvania: Lu Ann Brady, MS, Chief Operating Officer; Donna Capozzi, PharmD, Associate Director of Ambulatory Services, Department of Pharmacy; Regina Cunningham, PhD, RN, NEA-BC, FAAN, Chief Executive Officer. Penn Medicine Center for Health Care Innovation: David Asch, MD, MBA, Executive Director; Jeremy Asch, Innovation Strategist; Roy Rosin, MBA, Chief Innovation Officer

Disclosures: Dr. Bekelman reported receiving grants from Pfizer, UnitedHealth Group, Blue Cross Blue Shield of North Carolina, and Embedded Healthcare and personal fees from the Center for Medicare & Medicaid Services, Optum, CVS Health, and the National Comprehensive Cancer Network, outside the submitted work. All other authors have nothing to disclose.

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