

# Using Evidence to Design Cancer Care Facilities

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Leonard L. Berry, PhD, MBA<sup>1,2</sup> , Jonathan Crane, FAIA<sup>3</sup> ,  
Katie A. Deming, MD<sup>4</sup> , and Paul Barach, BSc, MD, MPH<sup>5,6</sup> 

## Abstract

The nuts and bolts of planning and designing cancer care facilities—the physical space, the social systems, the clinical and nonclinical workflows, and all of the patient-facing services—directly influence the quality of clinical care and the overall patient experience. Cancer facilities should be conceived and constructed on the basis of evidence-based design thinking and implementation, complemented by input from key stakeholders such as patients, families, and clinicians. Specifically, facilities should be designed to improve the patient experience, offer options for urgent care, maximize infection control, support and streamline the work of multidisciplinary teams, integrate research and teaching, incorporate palliative care, and look beyond mere diagnosis and treatment to patient wellness—all tailored to each cancer center's patient population and logistical and financial constraints. From conception to completion to iterative reevaluation, motivated institutions can learn to make their own facilities reflect the excellence in cancer care that they aim to deliver to patients.

## Keywords

evidence-based design, patient experience, quality, oncology

The design of facilities that deliver cancer care profoundly affects patients, families, clinicians, administrators, and other stakeholders. These facilities are expensive to build and, once built, exist for decades. Their design is constrained not just by physical space but also by the often competing demands of operational efficiency, safety, and finances. Despite extraordinary focus on patient safety, preventable adverse events and other patient harms persist.<sup>1,2</sup> Shortcomings in facility design contribute to these lingering challenges.<sup>3</sup>

Facility design endeavors often violate the cardinal principle of system coproduction, whereby users actively participate in the design process. Without that participation, trust and the delivery of safe, value-driven care are undermined.<sup>4</sup> Indeed, financial considerations often are prioritized over patients' and staffs' needs, even though each is critical to achieve optimal results. This choice can cause, for example, an overemphasis on maximizing space, resulting in mazes of small rooms and in the missed opportunity to orient waiting areas and other common spaces toward exterior views of nature that can have a calming effect on facility occupants.

The research team believes that a well-designed cancer center can prioritize the patient and family's experience while still achieving operational excellence. This argument is rooted in evidence-based principles of design,<sup>5</sup> and the team offers context-sensitive suggestions

for improvement and implementation. The aim is to guide oncology clinicians, health care leaders, and facility experts as they work with designers of cancer centers to align their efforts with emerging care trends that can benefit *all* stakeholders.

## Learn From the Evidence

Just as the evidence base matters when diagnosing, treating, and caring for patients with cancer, it also is crucial to the design of cancer care facilities. Design professionals, facility managers, and health care leaders can consult an extensive literature on evidence-based design of health care facilities,<sup>5-9</sup> registry data on quality and safety, and stakeholder knowledge to inform optimal facility design. Rigorous evidence on how physical, social, and symbolic environments affect care must be

<sup>1</sup>Texas A&M University, College Station, TX

<sup>2</sup>Institute for Healthcare Improvement, Boston, MA

<sup>3</sup>HDR, Inc., Atlanta, GA

<sup>4</sup>Kaiser Permanente Northwest, Portland, OR

<sup>5</sup>Wayne State University, Detroit, MI

<sup>6</sup>Jefferson College of Population Health, Philadelphia, PA

### Corresponding Author:

Leonard L. Berry, Department of Marketing, Mays Business School,  
Texas A&M University, 4112 TAMU, College Station, TX 77843-4112.  
Email: BerryLe@tamu.edu

made actionable so that the information ultimately supports therapeutic relationships while improving patient safety and care quality.<sup>10</sup> Evidence-based design brings empiricism to the design process, complementing imagination and judgment.<sup>5</sup> For example, research has shown the importance of empowering patients and families to, when necessary, remind clinicians to clean their hands before commencing care.<sup>11,12</sup> However, this practice can be effective only if handwashing sinks and gel dispensers are clearly visible in the room.

Medical evidence about what does and does not work in caring for cancer patients is not static. The same is true in facility design. The learning process is iterative and typically incremental, constantly infused by daily lessons from real patients and the clinicians who provide their care. Following is a review of design interventions that align with trends in cancer care and are consistent with available evidence, with the caveat that design must be tailored to the specific institution.

## Improve the Patient Experience

Cancer patients differ by diagnosis, prognosis, therapy, health status, ethnicity, sex, income, age, and outlook.<sup>13</sup> Patients' needs also vary day by day and visit to visit. Facility design can either enhance or undermine the experience of patients and family members, who spend considerable time at care sites. Without words, a facility's design can succeed or fail in symbolically communicating respect and patient-centeredness. Giving patients and families options to address their changing needs, when possible, enhances their experience.<sup>14-16</sup> At the most basic level, that means seeing patients not as passive recipients of medical intervention but as partners who coproduce and "own" their own health.<sup>17</sup>

Operational efficiency and patient safety should guide the design of cancer facilities, but opportunities also abound to offer patients and families greater choice, control, and comfort in using those facilities. For instance, proximity to bike paths and walkways can serve as alternative, more-healthy means of access for willing and able patients. Choices of valet or self-parking can increase patient and family satisfaction. Infusion therapy spaces can offer a choice of private or group settings—and welcome family members into the infusion process.<sup>14</sup> A well-designed infusion therapy space situates patients within the view of staff for early signs of deterioration and discomfort without compromising patient privacy. A common design feature of Kaiser Permanente cancer clinics is placing the infusion pharmacy adjacent to the infusion therapy space. This sensible design allows pharmacists to easily counsel patients and families, answer their questions, and establish a personal relationship during infusion treatments. Patients are given the direct phone

number of the infusion pharmacy. Knowing the pharmacist who prepares the chemotherapy that can make one feel quite sick—with an option to get in touch—offers a degree of control and comfort that often eludes cancer patients and family members. Knowing the patient reinforces to pharmacists their vital contribution to high-quality care.

Creating multiple entry points to different areas of a facility, such as radiation therapy, can expedite check-in, reduce walking distances for patients with limited mobility and stamina, and offer privacy. Facilities should be designed to maximize natural light, outside views, and direct access to nature (eg, gardens, walking paths) while offering positive distractions such as art and music. Nurturing, reflective spaces often reduce stress for patients, families, and staff—and emotionally rejuvenate them.<sup>3,5,6,17-19</sup>

Another way to improve the visit experience is to offer multiple small waiting areas along the flow of services: check-in, blood draws, lab testing, physical examination, and infusion or radiation. This approach can reduce congestion and the sense that the center is impersonal and institutional. Waiting room furniture can be arranged to accommodate family and social groups in diverse configurations that support privacy and comfort.<sup>20</sup> Chairs and benches can be complemented by work bars (with wireless access and USB ports) and tables of varying heights, to allow a choice of wait time activities.

## Integrate Urgent Care

Not all cancer care is planned for in advance. Studies document cancer patients' frequent visits to the emergency department (ED) for poorly controlled symptoms, such as nausea and pain, with many then hospitalized.<sup>21,22</sup> Several hospital systems, including Yale's Smilow Cancer Hospital and the University of Texas Southwestern Medical Centers, have demonstrated reduced ED visits with implementation of oncology-specific urgent care services.<sup>23,24</sup> Incorporating urgent care into cancer center design has the potential to reduce stressful, expensive ED visits and hospitalizations while addressing patients' unique, cancer-specific needs.

When adverse events occur, patients might have the option of initial contact through a direct-triage phone line, followed (if needed) by access to on-site delivery of urgent therapy.<sup>25</sup> For example, a patient who has unilateral extremity swelling often is sent to the ED or unaffiliated urgent care for workup of a potential blood clot. In a cancer center with integrated urgent care services, this patient could be managed by the oncology team, undergo appropriate testing (ultrasound), and then receive treatment as appropriate. Patients then receive care from clinicians who are best prepared to provide it.<sup>26</sup>

Urgent care units with off-hours access generally have exam, infusion, and procedure spaces. Some cancer centers may offer urgent care by adding bays or chairs with private, sound-insulated alcoves to existing treatment areas. Centers offering 24/7 infusion therapy also may use those spaces for urgent care. A key design consideration is easy access for patients. Educating patients and families about the risk factors for adverse events (eg, bleeding, vomiting), and what to do when they occur, also can reduce avoidable ED and urgent care visits.

## Design for Infection Control

Given that many inpatients, especially those with cancer, are admitted with or are susceptible to infections, a crucial goal for hospital design is infection control. Radical treatments, such as stem cell transplantation or immunotherapies, often require a heightened emphasis on preventing infection.<sup>27</sup> An integrated approach to high-efficiency air ventilation and filtration, hand hygiene, water systems, and choice of material finishes has been shown to reduce the risk of infection from the hospital environment.<sup>3,28</sup> Placing sinks and disinfecting stations where staff and family find them easy to routinely sanitize hands before contact with patients can increase adherence to infection-control protocols.<sup>5</sup> Clearly separating the flows for clean and soiled materials—and having adequate space to hold both—also reduces risks for contamination.<sup>29</sup>

Evidence is strong that investing in single-patient hospital rooms is likely to reduce the rate of nosocomial infections.<sup>5,7,30</sup> In the largest-ever hospital move in Canadian history, Montreal's McGill University Health Centre's new 350-bed facility with all private rooms replaced an older 417-bed hospital that primarily had mixed 3- or 4-person ward-type rooms. The move to the new hospital resulted in immediate and sustained reductions in methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococcus (VRE) colonization, and VRE infection—while not being associated with reduced *Clostridium difficile* or MRSA infection.<sup>30</sup>

Implementing infection control begins with creating a safety-management system that (a) articulates a vision and a standard set of activities for delivering infection-free cancer care within a health system; (b) identifies organizational and operational factors (eg, political will, staff motivation, resources, schedules, supplies, equipment) that affect the implementation of, and adherence to, infection-control practices; and (c) develops tailored, locally appropriate strategies to encourage systematic reflection and learning. In essence, effective infection hazard reduction and risk management require a systems-based perspective on how teams of people who

deliver care interact with one another, with patients, and with the equipment and materials they use—and on how operational and organizational protocols govern those interactions.<sup>31</sup>

## Support Multidisciplinary Coordination

Evidence shows that outcomes in multidisciplinary care depend on effective team performance.<sup>32,33</sup> Cancer care is highly complex and requires effective communication, collaboration, and coordination among those who “share care” of an individual patient.<sup>34</sup> In effect, multidisciplinary care offers the benefits of team-based peer review.<sup>35</sup> Poor facility design can contribute to teamwork deficiencies.<sup>36</sup> For instance, building layouts often separate potential members of multidisciplinary teams, undermining opportunities for more frequent trust-building interactions. With purposeful planning, facilities can be designed around the clinical microsystem to foster trust, timely communication, and coordination—thereby making multidisciplinary teams more effective.<sup>37,38</sup>

The key is to be deliberative about how the complex components of a comprehensive cancer center team come together, with a focus on joint pathways and destinations. For example, multidisciplinary clinic spaces that allow patients to be seen by several providers on the same day can be created. Integris Cancer Institute, in Oklahoma City, brings interdisciplinary specialists together for prospective case discussion of newly diagnosed cancer patients, followed by meetings with the patients (and often family members), all in one day in one place. This multidisciplinary cancer clinic (MDCC) program resulted from patient research before the Institute opened in 2009. The research highlighted patients' desire to see specialists and begin treatment in a timely manner, to receive coordinated care, and to be expertly guided through the complexity of cancer treatment.

MDCC sessions are biweekly, specific to cancer type (such as gastrointestinal or lung cancer), and coordinated by a patient navigator who documents the multidisciplinary treatment plan, assists patients with making appointments, introduces available complementary supportive services (eg, psychosocial counseling, social work), and follows patients throughout treatment. Design plays a key role. Registration is only steps away from the main entrance, and patients are personally walked to the clinic space where they meet their care team. The MDCC preconference (similar to a tumor board meeting) is held in a conference room just inside the entrance for easy access by visiting clinicians and is specifically designed to facilitate both in-person (U-form table formation) and remote (advanced videoconferencing) communication.

According to the Integris Cancer Institute, the MDCC program's benefits include significant mean reductions in days from diagnosis to treatment: for gastrointestinal cancers, for example, the average declined from 54 days in 2010 to 23 days in 2018; for genitourinary cancers during the same period, the average declined from 71 days to 14 days.

## Incorporate Research and Teaching

Investigational and experimental therapy protocols can conflict with efficient delivery of care in academic cancer centers that conduct research and training. Problems can ensue if competing goals are not addressed in the facility design. Given the rapid increase in new cancer therapies and their concomitant use with existing therapies, the following aspects of facility design merit attention in academic cancer centers:

- Provide space for enrolling and processing research participants and for sample banking
- Maintain a small lab for initial research sample processing to reduce sample degradation
- Increase exam room capacity and incorporate audiovisual technology for research and teaching during patient visits
- Integrate research blood draw capacity with standard of care draws and workflows
- Increase infusion space for experimental therapeutics, accommodating potentially longer visits with sicker patients
- Integrate research drugs and new therapies, such as viral vectors, into on-site pharmacies
- Designate space for researchers and coordinators to do desk work for research projects and clinical trials
- Provide space for team reflections and debriefings
- Dedicate space for sponsor audits of clinical trials

The MD Anderson Genitourinary Cancer Clinic illustrates how intentional design can support clinical, research, and teaching activities within the normal flows of clinical care. Well-placed spaces for patient consent, interviews, blood draws, and sample preparation enable patients to conveniently participate in research and clinical trials and for staff to engage unimpeded in care, research, and teaching. Design that supports simultaneous clinical care, research, and teaching can enhance the speed and quality of the work while limiting interpersonal friction among people who share common spaces to accomplish different missions.

As new therapies and combination therapies are increasingly used, gathering data on safety and efficacy will become more important and complex. Integrating

research, teaching, and optimal care—rather than letting them compete—can yield more efficient, effective use of space and personnel.

## Integrate Palliative Care

Integrating palliative care into mainstream cancer care improves the overall care experience, enhances patients' quality of life, reduces the use of health care resources, and may improve patient outcomes.<sup>39-42</sup> Co-locating palliative care nurses, doctors, and social workers within a cancer center can facilitate better symptom management and utilization of palliative services.<sup>43</sup> Patients then become more aware of palliative care and gain simpler and earlier access to it; collaboration between palliative care clinicians and the rest of the oncology team becomes more convenient and effective.

Facility design can help optimize the placement and integration of palliative services. Issues to consider include office space for interdisciplinary palliative care teams and space to meet with patients and families. It is ideal to create dedicated space for the palliative care team adjacent to or within the oncology clinic. Embedding the palliative care team in the clinic is likely to increase utilization of palliative care not only through referrals but also on an ad hoc basis. For example, an oncologist may conduct a curbside consult with a palliative care physician on symptom management for a patient, or may have the palliative care nurse see the patient after the oncologist's visit to address symptoms.

Princess Margaret Cancer Centre, in Toronto, directly integrates palliative care with both ambulatory and inpatient oncology care in the design of its 18-story facility. The inpatient palliative care unit on the 16th floor is a 12-bed unit that provides symptom management and care transition services, including end-of-life care. The space is designed both to support care teams assisting with relief of physical and psychological symptoms and to allow the family to be present and involved. The palliative care unit is designed as an oasis of calm within the hospital. An evidence-based use of color and wood purposefully creates a serene, quiet environment without the visible attributes and clutter typical of many hospital inpatient units. Patients and family also have access to an indoor and outdoor meditation garden nestled on the hospital's 14th floor.<sup>44</sup>

## Design Beyond Diagnosis and Treatment

The increasing success of new cancer therapies creates an opportunity to offer improved services both earlier and later in the cancer care continuum. On the front end, integrating cancer prediction, prevention, and early

detection into the care service line can reduce the incidence of cancer and delays in diagnosis. The integrated center model, developed for breast cancer in the early 1980s with mammography for early detection and now expanded to other technologies such as genetic and familial screening, could be extended to other cancer services.

As newer, more efficacious cancer therapies extend life, facility design will be an important component of expanding clinical and rehabilitation services to address both the adverse effects of treatment and the mental and social aspects of living longer with cancer. Many cancer centers have multifaceted, holistic care programs that support patients physically, emotionally, and spiritually for both the short term and the long term. These programs, traditionally referred to as complementary and alternative medicine and increasingly referred to as integrative oncology, include services such as music therapy, meditation, yoga, massage, acupressure, acupuncture, and stress management.<sup>45,46</sup> A growing evidence base supports combining these services to address specific issues—for example, a combination of music therapy, meditation, stress management, and yoga to mitigate anxiety and stress.<sup>46,47</sup>

Integrative oncology, preventive services, and rehabilitative services require collaboration among many different entities, and careful facility design can optimize their complementarity. For instance, in rehabilitation services, new technologies (such as robotic and antigravity physical assistive devices, and video gaming) are rapidly increasing options for effective therapy. Including well-designed space for rehabilitation programs will be crucial for the next generation of cancer facilities.

Chicago's Shirley Ryan Ability Lab (SRALab) designed its new 26-story facility to support individualized rehabilitative cognitive, physical, and occupational therapies for patients treated for cancer and other debilitating illnesses and injuries. Space is geared to the impairment requiring therapy (ie, speech and thinking, legs and walking, arms and hands, strength and endurance). A patient having neurosurgery for a brain tumor may, for example, require different therapies for cognitive issues, balance and gait limitations, and strength and endurance challenges. What SRALab does especially well in oncology rehabilitation is use the capabilities of the entire building to support oncology rehabilitation specialists and therapists, clinical teams, researchers, social workers, and psychologists to work well together to support patients' individual needs and goals.<sup>48</sup>

SRALab uses evidence-based colors to create an active setting for physical activity and a calming setting required for therapy. The building orientation and design offer

patients, families, and staff views of Chicago and Lake Michigan. Extra-wide corridors have curved corners for better sight lines and mobility. Ceilings are designed for patients lying on their backs, incorporating motivational graphics that communicate wellness.

### Case Study: Lessons From Nebraska

The University of Nebraska Medical Center (UNMC) Fred and Pamela Buffett Cancer Center in Omaha, Nebraska, opened in 2017 with the aim of pooling rapidly advancing knowledge (from clinical experience and research) and using it to foster integrated, coordinated care. This integrated facility offers comprehensive cancer care, as well as teaching and research, under one roof. It is designed to simplify the patient journey and to facilitate multidisciplinary care and research teams. Principles of evidence-based design were employed to achieve less stressful, more satisfying patient, family, and staff experiences; to support efficient clinical operations; to facilitate patient safety; and to foster development and transfer of knowledge across clinical and research teams. Table 1 lists 12 of the center's design strategies.

The design process for the Buffett Cancer Center engaged both patients and staff in identifying important touchpoints in the patient and family cancer care experience. The facility offers extensive access to daylight and views to nature, a sanctuary designed by glass artist Dale Chihuly as the cornerstone of a new healing arts program, family-friendly rooms, art, music, appropriate food service, and a full range of amenities. It offers the choice of valet or self-parking and access to all ambulatory and inpatient services and treatment modalities from one elevator bank. The previously 3-quarter-mile journey around the campus for cancer care has been replaced with centralized clinical services in one facility, including access to 24-hour urgent care.

It is always perilous to correlate improved patient and staff outcomes with specific design interventions, given the many potentially confounding variables. In UNMC's case, operational changes to improve patient care and satisfaction across the entire institution were made around the same time the cancer center opened. The Buffett Center does have promising raw data after the first year of clinical operations that suggest positive change: a 16% increase in unique patients seen in the center's clinics and treatment centers, hiring of 13 new physicians and scientists, and an 80% increase in patients enrolled in clinical trials. The design of the new facility appears to be contributing to increased satisfaction—based on many positive comments received from patients, families, and staff to date, and to high and improved Press Ganey scores for both inpatient and ambulatory care.

**Table 1.** Design Strategies at the Fred and Pamela Buffett Cancer Center.

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Standardize room size, layout, equipment, and supplies.
Install in-room sink allowing physician/staff to handwash in patient view.
Create charting alcove with window, increasing patient visibility for nurses, physicians, and staff.
Provide private room offering personal privacy, larger patient bathrooms, and wider doors.
Ensure close proximity between bed and bathroom, reducing the potential for patient falls.
Create sitting area and guest fold-out bed to encourage family support and involvement with care.
Provide accessible information systems at the point of service.
Reduce noise with low-vibration design, use special noise-absorbing ceiling tiles, and eliminate overhead paging.
Install ceiling-mounted or mobile lifts.
Increase access to natural light with oversize windows, providing a “healing” view.
Use music/art as a positive distraction.
Design clinical and research teams in close proximity adjacent to the clinical microsystem.

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## Evaluate, Implement, and Deliver Value

Designing a cancer-care facility involves daunting complexities, including detailed advance planning, reconciling the needs and wants of different stakeholders, and context-specific constraints for scale and sustainability. Design components well beyond clinical care matter greatly.

Cancer facility design initiatives are challenging to evaluate on a continuous basis while maintaining accuracy, cooperation, and transparency. Evaluation results may be unreliable when the influence of factors such as patient variation and staff experience on clinical outcomes, safety, cost, and satisfaction cannot be attributed with precision. Nonetheless, ongoing efforts to evaluate facility-influenced results against design goals are essential. Otherwise, it is difficult to determine what is and is not working to inform future design work, and the generalizability of lessons for other cancer facilities will be limited.<sup>49</sup> Cancer centers can use the following approaches to help assess how well their facility design is delivering value:

- Embed researchers and rigorous research protocols into physical and organizational design initiatives<sup>50</sup>
- Track quality metrics such as adverse events, infection rates, timeliness of care, and ED/urgent care visits
- Include evaluation of design in patient and staff satisfaction research (eg, satisfaction with treatment spaces)
- Monitor and document changes in efficiency of care delivery and protocol adherence
- Track patient flow, cost of care, and waste metrics within the system
- Conduct regular administrative rounds in the facility to receive direct feedback from patients, families,

and staff—and to observe how the facility is being used

Having a clear strategy for evaluating implementation efforts—not merely for soliciting design ideas—is essential in ensuring the long-term value of facility design initiatives.

## Conclusion

Cancer care leaders and clinicians place enormous emphasis on quality of clinical care, often with great success. But some of the shortcomings in care that nevertheless persist can be addressed by seeing a facility’s design—its physical space, social contexts, and patient-facing systems and processes—as integral to how care is delivered. The design of a cancer facility reaches its greatest potential when it is derived from a documented body of evidence and the input of stakeholders, and applied judiciously to a particular clinical context and population within known constraints. By sharing specific design interventions that align with trends in cancer care, supported by examples of how they can be implemented, the research team hopes to advance the cause of evidence-based facility design in oncology. The aim is to encourage cancer care leaders to use accumulating knowledge about how best to enable cancer facilities themselves to embody the excellent care they seek to deliver.

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## ORCID iDs

Leonard L. Berry  <https://orcid.org/0000-0002-9110-7502>

Jonathan Crane  <https://orcid.org/0000-0001-5766-7971>

Katie A. Deming  <https://orcid.org/0000-0001-8313-5442>

Paul Barach  <https://orcid.org/0000-0002-7906-698X>

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