TOOLS

Intensive Care Patient Room Annotation

Design Elements, Related Outcomes, and Design Strategies

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Layout-Overall	Improved patient mobility and reduced falls	Space for clearly defined patient/family/caregiver zones	(Brown & Gallant, 2006; Calkins, Biddle, & Biesan, 2012; Pati, Cason, Harvey, & Evans, 2010)
		Clearances for wheelchair, furniture and medical equipment	
		Clearance between bed and chair enabling pivot-turn for wheelchair	
		Bathroom door visible to the patient while in bed	(Calkins, Biddle, & Biesan, 2012)
		Large bathroom door openings to accommodate patient, attached equipment and caregiver	(Calkins, Biddle, & Biesan, 2012)
		No equipment or other obstruction in the path from bed to bathroom	(Calkins, Biddle, & Biesan, 2012; Hitcho et al., 2004)
		Adequate numbers of patient rooms and bathrooms designed specifically for bariatric patients	
		Spatial clearance (e.g. door width) for bariatric patients	
	Reduced risk of contamination	Single bed patient room	(Bartley, Olmsted, & Haas, 2010; Ben-Abraham et al., 2002; Chang, 2000; Bracco, Dubois, Bouali,& Eggiman, 2007; Gardner, Court, Brocklebank, Downham, & Weightman, 1973; MacKenzie et al., 2007; McManus, Mason, McManus, & Pruitt, 1992)
		Private bathroom for individual patients	(Ben-Abraham et al., 2002; Chang, 2000; Bracco, Dubois, Bouali, & Eggiman, 2007; Gardner, Court, Brocklebank, Downham, & Weightman, 1973; McManus, Mason, McManus, & Pruitt, 1992)
	Efficient delivery of care	All elements in the patient room located and oriented uniformly across all patient rooms	
		Space allotted based on detailed analysis of mobile equipment (such as: intravenous [IV] pumps, medication cart, crash cart, portable lifts, telemedicine equipment) which may be used in the room, and their location	
		A clear path to move the bed in/out of room	
		Minimum environmental obstacles that interfere with care delivery (e.g. starting an intravenous [IV] pump, monitoring vitals, helping patient to bathroom)	(Hitcho et al., 2004)
		Clearly defined zones for patient, family and caregiver	(Brown & Gallant, 2006; Hendrich, Chow, 2008; Pati, Cason, Harvey, & Evans, 2010)
		Adjacencies to minimize staff walking and increase efficiency	
		Sufficient space and provision for equipment, medical gases, and power capacity to accommodate different levels of patient acuity including codes	(Annonio, Graham, Ross, 2010; Brown & Gallant 2006; Hendrich, Fay, & Sorrells, 2004; Zimring & Seo, 2012)
		Locations of equipment verified with various caregivers for ease of access and use	
		Sufficient spaces for the use of bedside electronic medical records (in-room EMR devices including computers, barcode scanners, etc.)	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Layout-Overall	Improved communication	Place for a physician/nurse to sit/stand around the patient bed to converse with the patient	
	Improved job satisfaction	Large single rooms	(Berry & Parish 2008; Harris, Shepley, White, Kolberg, & Harrell, 2006)
		Flexible patient room layout accommodating care activities when patient needs change (e.g. sufficient spaces for various care activities)	(Janssen, Klein, Harris, Soolsma, & Seymour, 2001)
	Reduced patient stress, pain, anxiety, delirium	Single-bed patient rooms	(Arenson, MacDonald et al., 2013; Zaal, Spruyt et al., 2013)
		Nature view out of window in patient's line of sight	(Dijkstra, Pieterse, & Pruyn, 2006; Lee et al., 2004; Miller, Hickman, & Lemasters, 1992; Schneider, Prince-Paul, Allen, Silverman, & Talaba, 2004; Tse, Ng, Chung, & Wong, 2002; Ulrich, 1984; Ulrich, 1999; Ulrich, Lunden, Eltinge,1993)
		Unappealing elements hidden from view (trash cans, soiled linen, scrub basin, sharps container, etc.)	
	Improved patient satisfaction	Single-bed patient rooms	(Harris, Shepley, & White, 2006; Soufi et al., 2010)
		Flexible patient room layout accommodating care activities when patient needs change (e.g. acuity-adaptable rooms, universal rooms) to reduce need for patient transfers	(Hendrich, Fay, & Sorrells, 2004)
	Improved comfort	Accommodation for amenities for patient and family as considered appropriate, such as power outlets, phones, etc.	
	Reduced noise	Single-bed patient rooms	(Hilton, 1985)
	Enhanced privacy	Single-bed patient rooms	(Mlinek & Pierce, 1997)
		Minimum perceived visibility from corridor or public; caregiver can see the patient in a manner that protects patient's privacy	
	Enhanced security	A clear path for caregiver exiting from room in case of any violence from patient or family members	
	Change-readiness/future-proofing	Adequate room size to absorb additional functions as needed (such as an additional bed in case of emergencies)	
Layout-Staff Zone	Safe delivery of care	Medication Safety Zones (MSZ) identified within the patient room	
		MSZ located out of circulation paths to limit interruption and distraction	(Flynn et al., 1999; United States Pharmacopeia–National Formulary, 2010; Westbrook, Woods, Rob, Dunsmuir, & Day, 2010)
		Space provided for medication associated equipment (e.g. barcode reader) and safety technology (e.g. computerized physician order entry [CPOE]) in the MSZ	(Bates et al., 2001; Poon et al., 2010)
		Space provided for mobile medication-dispensing cart	
		Organized and uncluttered workspace in the MSZ	
		Sharps container that is easy to access	
	Efficient delivery of care	Space for charting (electronic medical record [EMR] and manual) away from sink	
Layout-Patient Zone	Safe delivery of care	Direct and short visual sightline to patient from corridor/ decentralized nursing station (ability to see patient's head)	(Harvey & Pati 2012; Pati, Cason, Harvey, & Evans, 2010; Seo, Choi,& Zimring, 2011)
		Room layout that minimizes walking distance from nursing stations to patient bed	(Gurascio-Howard & Malloch, 2007)
		Minimum visual obstacles between nursing stations and patient head (e.g. glass doors, windows on doors)	
	Efficient delivery of care	Space at headwall/footwall for emergency procedures	
		Bed and chair clearances for safe patient handling	
		Space for preparation for clinical procedures	
		Space for people and equipment in a code blue response	
		Space accommodation for patient handling/movement equipment (e.g. ceiling lifts)	(Chhokar et al., 2005; Cohen et al., 2010; Joseph & Fritz, 2006; Marras, Knapik, Ferguson, 2009)
	Reduced noise	Bed location/orientation to move patient head away from the door (without compromising patient monitoring)	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Layout-Family Zone	Improved communication	Family space positioned in line of sight of staff so they can be included in the conversation	
		Furniture configured to facilitate communication	
	Improved family presence and engagement in patient care	Furniture (desk/chair/sleeper chair) that does not encroach into the patient/caregiver zone	
		Family ability to see and hear the TV without disturbing the patient	
		Visual connection between family and patient zones	
		Ability for family to reach out and touch patient, and provide bedside care	
		Access to areas outside of patient room, but in close proximity for family breaks (lounge, meditation room)	(Mroczek, Mikitarian, Vieira, & Rotarius, 2005; Samuels, 2009)
Flooring	Improved patient mobility and reduced falls	Flush flooring transitions	(Gulwadi & Calkins, 2008)
		Flooring stable, firm and slip-resistant, especially around water usage area (e.g. bath, shower)	
		Minimum joints and seams to ensure that sharp edged objects, like walking sticks or heels, do not cause trips	
		Low reflectance value (LRV) of finish to minimize glare	(Dvorsky & Pettipas, 2007; Gulwadi & Calkin, 2008; Nanda, Malone, & Joseph, 2012; Willmott, 1986)
		Low contrast in flooring patterns	(Calkins, Biddle, & Biesan, 2012; Nanda, Malone, & Joseph, 2012; Perritt, McCune, & McCune, 2005)
		Minimum changes between flooring types within the room	(Calkins, Biddle, & Biesan, 2012; Nanda, Malone, & Joseph, 2012)
	Reduced risk of injury	Flooring with energy-absorbent properties (to absorb the force of impact that causes injury, for example rubber) balanced with firmness (to reduce the risk of falling due to poor balance)	(Laing & Robinovitch, 2008; Nanda, Malone, & Joseph, 2012; Redfern & Cham, 2000; Wright & Laing, 2011)
	Reduced risk of contamination	Smooth surfaces, with minimum perforations and crevices	
		Minimum ridges or reveals that could serve as dust collectors	
		Manufacturers' recommended cleaning protocols for the selected surface and finish materials compatible with recommendations by CDC (Centers for Disease Control and Prevention) Guidelines for Environmental Infection Control in Health-Care Facilities	(Kramer, Schwebke, & Kampf, 2006; Lankford et al., 2006; Sehulster et al., 2003)
		Coved right angles between wall and floor	
		Joints and seams treated for easy clean/maintenance	
	Improved staff health	Balance of floor cushioning for underfoot comfort with roller mobility to address staff fatigue associated with standing as well as pushing heavy equipment	(Gray, 2009; Hughes, Nelson, Matz, & Lloyd, 2011; Nanda, Malone, & Joseph, 2012)
	Improved job satisfaction	Attractive design in staff work zone and other areas (non-institutional materials and colors)	(Folkins, O'Reilly, Roberts, & Miller, 1977)
		High durability to minimize visual cracks, stains and damages	
		Noise-reduction measures in patient room including staff work zone (e.g. sound absorbing finishes)	(Applebaum, Fowler, Fiedler, Osinubi, & Robson, 2010; Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005)
	Reduced patient stress, pain, anxiety, delirium	Non-glare finishes	
		Floor that does not scratch/scuff easily	
		Non-institutional appearance	(Altringer, 2010)
	Improved patient satisfaction	Noise reduction measures (e.g. sound-absorbing finish materials)	(Van Rompaey, Elseviers,Van Drom, Fromont, & Jorens, 2012)
	Reduced noise	Flooring with high sound absorbing properties and low sound transmitting properties	(Nanda, Malone, & Joseph, 2012)
		Floor finish and sub-floor conditions that mitigate noise levels transmitted by adjacent spaces	(Nanda, Malone, & Joseph, 2012)

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Flooring	Enhanced privacy	Sound absorption or blocking measures to minimize sound transmission between patient rooms, and between patient rooms and corridors	(Barlas, Sama, Ward, & Lesser, 2001; Karro, Dent, & Farish, 2005; Mlinek & Pierce, 1997)
	Enhanced durability	Materials that can prevent the growth of mildew and mold due to moisture retention	(Sehulster et al., 2003)
		Materials with high lifecycle performance: minimum wear and tear over time; sustaining recommended cleaning protocols	(Sehulster et al., 2003)
		Flooring that sustains the impact of mobile equipment (e.g. flooring materials including adhesive compatible with equipment weight to avoid indentation) and other frequent wear and tear	(Nanda, Malone, & Joseph, 2012)
	Improved air quality	Minimum emissions of volatile organic compounds (VOCs)	
		Materials that meet guidelines laid out in Green Guide for Healthcare 2007; and Leadership in Energy & Environmental Design (LEED) for Healthcare Indoor Environmental Quality (IEQ)	
		Minimum need for surface coating and aerosol spray cleaners	
		Low toxicity of materials used	
	Enhanced sustainability	Finish materials with low hazardous content including plasticizers, volatile organic compounds, latex, and so on	(Bornehag et al., 2005; Galobardes et al., 2001; Holter et al., 2002; Jaakkola et al., 1999; Tuomainen et al., 2006)
		Finish materials' production associated with less energy use and lower level of greenhouse gas emission or recyclable materials	(Sedjo, 2002)
Wall	Improved patient mobility and reduced falls	Supported path (e.g. handrail) from bed to bathroom	(Calkins, Biddle, & Biesan, 2012; Tzeng & Yin, 2010)
	Reduced risk of contamination	Smooth surfaces, with minimum perforations and crevices	
		Minimum ridges or reveals that could serve as dust collectors	
		Manufacturers' recommended cleaning protocols for the selected surface and finish materials compatible with recommendations by CDC (Centers for Disease Control and Prevention) Guidelines for Environmental Infection Control in Health-Care Facilities	(Kramer, Schwebke, & Kampf, 2006; Lankford et al., 2006; Sehulster et al., 2003)
		Joints and seams treated for easy clean/maintenance	
		Wipe-able/washable, easy-to-clean /disinfect High Touch Surfaces with minimal joints/seams in the room	(Carling, Briggs, Hylander, & Perkins, 2006; Carling, Briggs, Perkins, & Highlander, 2006; Carling, Parry, & Von Beheren, 2008; Dancer, White, Lamb, Girvan, & Robertson, 2009; Joseph, & Rashid, 2007; Lankford et al., 2007; Takai et al., 2002; Wilson & Ridgway, 2006)
	Efficient delivery of care	Medical gases/power outlets mirrored on either side of the bed	
		Convenient nurse control over lighting and temperature	
		Locations of connections, outlets verified with various caregivers for ease of access and use	
		Sound-absorbing finish materials to reduce overall background noise level and consequently reduce the alarm volume level	
	Improved job satisfaction	Attractive design in staff work zone and other areas (overall aesthetics, non-institutional materials and colors)	(Folkins, O'Reilly, Roberts, & Miller, 1977)
		High durability for all elements (e.g. materials) to minimize visual cracks, stains and damages	
		Noise-reduction measures in patient room including staff work zone (e.g. sound absorbing finishes)	(Applebaum, Fowler, Fiedler, Osinubi, & Robson, 2010; Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005)

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Wall	Reduced patient stress, pain, anxiety, delirium	Non-glare finishes	
		Non-institutional looking finish materials (e.g. subtle/soft contemporary color, texture variety)	(Altringer, 2010)
		Noise reduction measures (e.g. sound-absorbing finishes)	(Van Rompaey, Elseviers,Van Drom, Fromont, & Jorens, 2012)
		Nature-themed artwork (print, electronic, or immersive) with unambiguous, clear, and culturally appropriate content in patient's line of sight (ensure that visibility is not impaired by glare)	(Kline, 2009; Nanda et al., 2012; Nanda, Eisen, Zadeh, & Owen, 2011; Ulrich & Gilpin, 2003; Ulrich, Simons, & Miles, 2003; Vincent, Battisto, & Grimes, 2010)
		Access to music (with choice and volume control)	(Chang & Chen, 2005; Lee et al., 2002, 2004; Thorgaard et al, 2005)
		Presence of clock and watch for patient's orientation to the time of day	(McCusker et al., 2001)
		Soundproof walls to block external noise (e.g. planes, traffic), if needed	
	Enhanced patient sense of control	Patient control of adjustable temperature, varied/dimmable lighting and shade, and entertainment within reach of bed and chair	
	Improved patient engagement	Patient access to electronic media for education and entertainment	
	Improved patient satisfaction	Positive visual distractions (e.g. nature scene artworks)	(Diette, Lechtzin, Haponik, Devrotes, & Rubin, 2003; Lee et al., 2004)
		Positive audio distractions (e.g. music, nature sounds)	(Chang & Chen, 2005; Lee et al., 2004)
		Non-institutional looking finish materials, fixtures, and furniture	(Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
		Noise reduction measures (e.g. sound-absorbing finishes)	(Hagerman et al., 2005)
		Intuitive and easy-to-use environmental controls	
	Reduced noise	Wall construction and finish blocking/absorbing sound from outside, corridor, and adjacent rooms	(Barlas, Sama, Ward, & Lesser, 2001; Karro, Dent, & Farish, 2005; Mlinek & Pierce, 1997)
	Improved air quality	Minimum emissions of volatile organic compounds (VOCs)	
		Materials that meet guidelines laid out in Green Guide for Healthcare 2007; and Leadership in Energy & Environmental Design (LEED) for Healthcare Indoor Environmental Quality (IEQ)	
		Minimum need for surface coating and aerosol spray cleaners	
		Low toxicity of materials used	
	Change readiness/future-proofing	Electrical power, data and medical gas outlets (number and spacing) in all zones (headwall, footwall, caregiver, patient and family zones)	
	Enhanced sustainability	Cost-effective insulation materials on exterior wall	(Khodakarami, Knight, & Nasrollahi, 2008)
		Finish materials with low hazardous content including plasticizers, volatile organic compounds, latex, and so on	(Bornehag et al., 2005; Galobardes et al., 2001; Holter et al., 2002; Jaakkola et al., 1999; Tuomainen et al., 2006)
		Finish materials' production associated with less energy use and lower level of greenhouse gas emission or recyclable materials	(Sedjo, 2002)
Ceiling	Reduced risk of contamination	Smooth surfaces, with minimum perforations and crevices	
		Minimum ridges or reveals that could serve as dust collectors	
		Manufacturers' recommended cleaning protocols for the selected surface and finish materials compatible with recommendations by CDC (Centers for Disease Control and Prevention) Guidelines for Environmental Infection Control in Health-Care Facilities	(Kramer, Schwebke, & Kampf, 2006; Lankford et al., 2006; Sehulster et al., 2003)
		Joints and seams treated for easy clean/maintenance	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Ceiling	Safe delivery of care	Noise-reduction measures to reduce noise level in MSZ (e.g. sound absorbing finishes, soundless alarms)	(Flynn, Barker, Gibson, Pearson, Smith, & Berger, 1996)
	Efficient delivery of care	Sound-absorbing finish materials to reduce overall background noise level and consequently reduce the alarm volume level	
	Improved job satisfaction	Attractive design in staff work zone and other areas (overall aesthetics, non-institutional materials and colors)	(Folkins, O'Reilly, Roberts, & Miller, 1977)
		High durability for all elements (e.g. materials) to minimize visual cracks, stains and damages	
		Noise-reduction measures in patient room including staff work zone (e.g. sound absorbing finishes)	(Applebaum, Fowler, Fiedler, Osinubi, & Robson, 2010; Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005)
	Reduced patient stress, pain, anxiety, delirium	Non-glare finishes	
		Non-institutional looking finish materials (e.g. subtle/soft contemporary color, texture variety)	(Altringer, 2010; Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
	Improved patient satisfaction	Noise reduction measures (e.g. sound-absorbing finish materials)	(Hagerman et al., 2005; Van Rompaey, Elseviers,Van Drom, Fromont, & Jorens, 2012)
	Reduced noise	Use of acoustic tiles with high noise reduction coefficient (NRC) ratings	(Blomkvist, Eriksen, Theorell, Ulrich, & Rasmanis, 2005; Joseph & Ulrich, 2007)
		Sound-absorbing ceiling construction and finish	(Joseph & Ulrich, 2007)
	Improved air quality	Minimum emissions of volatile organic compounds (VOCs)	
		Materials that meet guidelines laid out in Green Guide for Healthcare 2007; and Leadership in Energy & Environmental Design (LEED) for Healthcare Indoor Environmental Quality (IEQ)	
		Minimum need for surface coating and aerosol spray cleaners	
		Low toxicity of materials used	
	Enhanced sustainability	Finish materials with low hazardous content including plasticizers, volatile organic compounds, latex, and so on	(Bornehag et al., 2005; Galobardes et al., 2001; Holter et al., 2002; Jaakkola et al., 1999; Tuomainen et al., 2006)
		Finish materials' production associated with less energy use and lower level of greenhouse gas emission or recyclable materials	(Sedjo, 2002)
Window	Improved job satisfaction	Daylight accessible to staff when working in patient rooms	(Alimoglu & Donmez, 2005)
	Reduced patient stress, pain, anxiety, delirium	Presence of windows (with patient controlled shades) and other daylight harvesting methods (such as skylights)	(Beauchemin & Hays, 1996; Booker & Roseman, 1995; Choi, Beltrain, & Kim, 2012; Dijkstra, Pieterse, & Pruyn, 2006; Walch et al., 2005)
		Large windows for natural daylight and window views	(Beauchemin & Hays, 1996; Wilson, 1972)
	Improved patient satisfaction	Soundproof windows/walls to block external noise (e.g. planes, traffic), if needed	
		Non-institutional looking finish materials	(Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
		Glare sources (window) designed to minimize patient discomfort	
	Enhanced privacy	Prevention of patient being viewed from outside through exterior windows	
	Improved air quality	Minimum emissions of volatile organic compounds (VOCs)	
		Materials that meet guidelines laid out in Green Guide for Healthcare 2007; and Leadership in Energy & Environmental Design (LEED) for Healthcare Indoor Environmental Quality (IEQ)	
		Minimum need for surface coating and aerosol spray cleaners	
		Low toxicity of materials used	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Window	Enhanced sustainability	Double-glazed windows, low U-value (measure of heat loss) glazing	(Hien, Wang, Chandra, Pandey, & Wei, 2005; Menzies & Wherrett, 2005; Wong, Wang, Noplie, Pandey, & Wei, 2005)
		Solar shading (e.g. reflective internal solar shadings)	(Hashemi, A. 2014; Rosencrantz, Håkansson, & Karlsson, 2005)
		Materials with low hazardous content including plasticizers, volatile organic compounds, latex, and so on	(Bornehag et al., 2005; Galobardes et al., 2001; Holter et al., 2002; Jaakkola et al., 1999; Tuomainen et al., 2006)
		Materials' production associated with less energy use and lower level of greenhouse gas emission or recyclable materials	(Sedjo, 2002)
Door	Improved patient mobility and reduced falls	Bathroom door is visible to the patient while in bed	(Calkins, Biddle, & Biesan, 2012)
		Large door openings to accommodate patient, attached equipment and caregiver	(Calkins, Biddle, & Biesan, 2012)
		Spatial clearance (e.g. door width) for bariatric patients	
	Reduced risk of contamination	Wipe-able/washable, easy-to-clean /disinfect High Touch Surfaces with minimal joints/seams(e.g. door knobs) in the room	(Carling, Briggs, Hylander, & Perkins, 2006; Carling, Brigg, Perkins, & Highlander, 2006; Carling, Parry, & Von Beheren, 2008; Dancer, White, Lamb, Girvan, & Robertson, 2009; Joseph, & Rashid, 2007; Lankford et al., 2007; Takai et al., 2002; Wilson & Ridgway, 2006)
		Smooth surfaces, with minimum perforations and crevices	
		Minimum ridges or reveals that could serve as dust collectors	
		Manufacturers' recommended cleaning protocols for the selected surface and finish materials compatible with recommendations by CDC (Centers for Disease Control and Prevention) Guidelines for Environmental Infection Control in Health-Care Facilities	(Kramer, Schwebke, & Kampf, 2006; Lankford et al., 2006; Sehulster et al., 2003)
		Joints and seams treated for easy clean/maintenance	
	Safe delivery of care	Minimum visual obstacles between nursing stations and patient head (e.g. glass doors, windows on doors)	
	Improved patient satisfaction	Non-institutional looking finish materials	(Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
		Noise reduction measures (e.g. sound-absorbing finishes)	(Hagerman et al., 2005)
	Reduced noise	Door construction and finish blocking/absorbing sound from outside, corridor, and adjacent rooms	(Barlas, Sama, Ward, & Lesser, 2001; Karro, Dent, & Farish, 2005; Mlinek & Pierce, 1997)
		Minimal noise from equipment operation (e.g. door closure, curtain track)	
	Improved privacy	Sound absorption or blocking measures (e.g. acoustic ceiling tile) to minimize sound transmission between patient rooms, and between patient rooms and corridors	
		Minimum perceived visibility from corridor or public areas (e.g. windowless door):caregiver can see the patient in a manner that protects patient's privacy	
	Improved durability	Door warrantied for prolonged time	
		Materials that can prevent the growth of mildew and mold due to moisture retention	(Sehulster et al., 2003)
		Materials with high lifecycle performance: minimum wear and tear over time; sustaining recommended cleaning protocols	(Sehulster et al., 2003)
	Improved air quality	Minimum emissions of volatile organic compounds (VOCs)	
		Materials that meet guidelines laid out in Green Guide for Healthcare 2007; and Leadership in Energy & Environmental Design (LEED) for Healthcare Indoor Environmental Quality (IEQ)	
		Minimum need for surface coating and aerosol spray cleaners	
		Low toxicity of materials used	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Door	Enhanced sustainability	Materials with low hazardous content including plasticizers, volatile organic compounds, latex, and so on	(Bornehag et al., 2005; Galobardes et al., 2001; Holter et al., 2002; Jaakkola et al., 1999; Tuomainen et al., 2006)
		Materials' production associated with less energy use and lower level of greenhouse gas emission or recyclable materials	(Sedjo, 2002)
HVAC	Reduced risk of contamination	Easy-to-clean HVAC (heating, ventilation, and air conditioning) equipment	(Lutz, Jin, Rinaldi, Wickes, Huycke, 2003)
		Ultraviolet germicidal irradiation (UVGI) filters	(Menzies, Popa, Hanley, Rand, & Milton, 2003; Memarzadeh, Olmsted, & Bartley, 2010)
		High-efficiency particulate absorption (HEPA) filters	(Barnes & Rogers, 1989; Crimi et al., 2006; Hahn et al., 2002; Sherertz et al., 1987)
		Uniform, non-mixed airflow patterns whereby contaminants are directed toward exhaust registers and grilles	(Barnes & Rogers, 1989; Memarzadeh, 2011; Sehulster et al., 2003)
		Negative-pressured rooms for infectious patients, as needed	(Gustafson et al., 1982)
		Positive-pressured rooms for immunocompromised patients, as needed	(Gustafson et al., 1982)
	Improved comfort	Ventilation and air conditioning system accommodates temperature differences during different seasons	(Memarzadeh, 2011; Memarzadeh & Manning, 2000)
		Air exchange rate to avoid stuffiness without causing drafts	(Memarzadeh, 2011; Memarzadeh & Manning, 2000)
		Quiet heating, ventilation, and air conditioning (HVAC) system	
	Enhanced durability	Equipment warrantied for prolonged time	
		Insulating material for the variable air flow units selected to function for the projected lifecycle for the unit	(Memarzadeh, 2011)
	Improved air quality	High rate of air changes per hour	(Li et al., 2007; Memarzadeh, 2011; Menzies, Fanning, Yuan, & FitzGerald, 2000)
		Positioning of ventilation grilles on the ceiling for efficient ventilation and comfort	(Beggs, Kerr, Noakes, Hathway, & Sleigh, 2008; Memarzadeh, 2011; Yi et al., 2009)
		Equipment and other measures to monitor and control air quality (e.g. filtration, physical barriers) during construction/renovation	
	Enhanced sustainability	Energy-efficient heating, ventilation, and air conditioning (HVAC) systems	(Mathews, Botha, Arndt, & Malan, 2001; Mazzei, Minichiello, & Palma, 2002)
Lighting	Improved patient mobility and reduced falls	Night-lighting located between bed and bathroom	(Gulwadi & Calkins, 2008)
	Reduced risk of contamination	Minimum ridges, reveals, or horizontal surfaces on objects that could serve as dust collectors	
	Safe delivery of care	Task-lighting in the MSZ for 1. Computer order entry and handwritten order-processing if performed in the patient room 2. Medication preparation and administration 3. Visual confirmation of the correct patient (reading arm band), correct medication and dosage, identification and observation of the administration site	(Buchanan, Barker, Gibson, Jiang, & Pearson, 1991; United States Pharmacopeia–National Formulary, 2010)
		Natural and artificial lighting (quantity, quality and locations) for patient monitoring and assessment	
		Lighting enabling caregiver to check on the patient and equipment (intravenous [IV] pump etc.) during the night without disturbing patient	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Lighting	Efficient delivery of care	Lighting at point of care and around patient bed for detailed examination of patient	
		Lighting to support patient care activities in the room without disturbing the patient at all times of the day/night	
	Reduced patient stress, pain, anxiety, delirium	Lighting design allows lighting variation (i.e. bright light during daytime and reduced light during nighttime) for the purpose of maintaining patients' circadian rhythm	(Vinall, 1997)
	Improved patient satisfaction	Non-institutional looking finish materials (e.g. subtle/soft contemporary color, texture variety, soft/yielding furnishing)	(Altringer, 2010; Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
	Improved family presence and engagement in patient care	Lighting for family space that does not disturb patients	
	Enhanced sustainability	Energy-efficient lighting fixtures (e.g. light-emitting diode [LED] lighting fixture)	
		Lighting controls to reduce waste of energy for lighting (e.g. photoelectric dimming system, occupancy sensors)	(Guenther & Vittori, 2007; Li, Lam, & Wong, 2006)
Furniture	Improved patient mobility and reduced falls	Furniture sturdy and stable to support patient transfer and weight bearing requirements (including requirements for bariatric patients)	
		Chairs with armrests	
		Easily seen casters for rolling furniture which can be locked	
		Space beneath the chair to support foot position changes	
		Adjustable seat height and back to enable the sit-to-stand movement	
		Furniture designed for bariatric patients	
	Reduced risk of injury	No sharp edges in furniture and fixtures found in patient/caregiver pathways (e.g. rounded corners of casework)	
	Reduced risk of contamination	Minimum ridges, reveals, or horizontal surfaces on objects that could serve as dust collectors	
		Minimum surface joints/seams	
		Smooth & nonporous surfaces	
		Smooth & nonporous surfaces	
		Impervious material for upholstery	
	Reduced patient stress, pain, anxiety, delirium Improved patient satisfaction	Non-institutional looking finish materials (e.g. subtle/soft contemporary color, texture variety, soft/yielding furnishing)	(Altringer, 2010; Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
	Improved family presence and engagement in patient care	Comfortable and flexible accommodation/place (e.g. chair, sofa bed) for families to rest or lie down	
		Furniture configured to facilitate interaction between patient and family	
	Improved comfort	Furniture suitable for wide-age and size variations (consider bariatric populations)	
		Sleep sofa/ chair comfortable for overnight stay	
		Patient chair comfortable without compromising safety	
	Enhanced privacy	Furniture configured to allow patient and family privacy	
	Enhanced durability	Furniture warrantied for prolonged time	
Casework/ Storage	Reduced risk of injury	No sharp edges in fixtures found in patient/caregiver pathways (e.g. rounded corners of casework)	
		Spaces for storing patient handling/movement devices and accessories when not in use (in room or in other quickly accessible spaces in unit)	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Casework/ Storage	Reduced risk of contamination	Minimum ridges, reveals, or horizontal surfaces on objects that could serve as dust collectors	
		Top of casework, headwall and other fixed items visible and accessible to facilitate cleaning	
	Efficient delivery of care	Flexible but defined options for storage of common medical supplies (linens, medication, etc.), close to the patient (in or outside the room) to decrease staff time fetching supplies based on a confirmed supply policy	
		Visual and tactile discrimination between medical supplies through use of size, color and texture	
		Sufficient spaces for storage of bedside electronic medical records (in-room EMR devices including computers, barcode scanners, etc.)	
	Reduced patient stress, pain, anxiety, delirium	Minimal visual clutter (e.g. equipment and wires) in the room	
		Equipment and wires hidden from patient view (e.g. stowed away equipment/surgical light, concealed gas outlets) when not in use but easily accessible when needed	
	Enhanced patient sense of control	Provision for secured storage in patient and family zone	
		Bed-side storage accessible to patient lying in bed	
	Enhanced security	Provisions to lock patient's valuables	
		Provisions to lock sensitive medical supplies	
	Change-readyness/furture-proofing	Reconfigurable casework	
Sink/ Alcohol Gel Dispenser	Reduced risk of contamination	Built-in sinks with seamless countertop surface	(Bartley, Olmsted, & Haas, 2010; Hota et al., 2009)
		Faucets located off-center (to the side of drain) to prevent bio-film splash	(Bartley, Olmsted, & Haas, 2010; Hota et al., 2009)
		Deep sink basins to prevent splashing from drain to other surfaces	(Bartley, Olmsted, & Haas, 2010; Hota et al., 2009)
		Water pressure modulated to prevent bio-film splash	(Bartley, Olmsted, & Haas, 2010; Hota et al., 2009)
		Distance or blockage between sinks and patient area to prevent bio-film splash to patient area	(Hota et al., 2009)
		Wipe-able/washable, easy-to-clean /disinfect High Touch Surfaces with minimal joints/seams(e.g. faucets, sinks) in the room	(Carling, Briggs, Hylander, & Perkins, 2006; Carling, Briggs, Perkins, & Highlander, 2006; Carling, Parry, & Von Beheren, 2008; Dancer, White, Lamb, Girvan, & Robertson, 2009; Joseph, & Rashid, 2007; Lankford et al., 2007; Takai et al., 2002; Wilson & Ridgway, 2006)
	Improved hand sanitation practices	ICRA (infection control risk assessment) reviewed location	
		Sink/dispenser visible to staff as they enter the room	(Nevo et al., 2010)
		Ergonomically design for ease of use (e.g. height suitable for staff population, faucet height/location, lighting, foot pedal [if any] location)	
		Sink/dispenser visible and accessible to patients and family but far away enough to prevent bio-film splash to patient area	
		Visual cues directing attention to sink/dispener	(Davis, 2010; Nevo et al., 2010)
		Electronic hand hygiene reminders	(Fakhry, Hanna, Anderson, Holmes, & Nathwani, 2012; Swoboda, Earsing, Strauss, Lane, & Lipsett, 2004)
		Sensor technology for faucets, towel dispensers, alcohol gel dispensers, soap dispensers etc.	(Larson, Albrecht, & O'Keefe, 2005)
		Other hands free mechanisms (e.g. wrist blades) for faucets, towel dispensers, alcohol gel dispensers, soap dispensers etc.	

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Sink/ Alcohol Gel Dispenser	Reduced noise	Minimal noise from equipment operation	
	Enhanced sustainability	Low-consumption flush valves and aerators on toilets, urinals, and lavatory faucets; flow control faucets	(Massachusetts Water Resources Authority, n.d.)
Patient Handling/ Movement Equipment (Ceiling Lifts)	Improved patient mobility and reduced falls	Clear path for use of patient handling/movement equipment (e.g. ceiling-lift) from patient bed to bathroom	(Calkins, Biddle, & Biesan, 2012; Joseph & Fritz, 2006)
		Standing assist aids/lifts with ambulation capacity	
		Patient handling/movement devices specifically designed for bariatric patients	
	Reduced risk of injury Improved staff health	Ceiling lifts for patient handling/movement (e.g. lifting arms/legs, lateral transfers, repositioning for patient care, transportation, and other tasks). Include coverage to the bathroom; using traverse tracks to ensure coverage to key locations in the room	
		Position of ceiling lift tracks for main patient handling/movement tasks (e.g. moving patient from bed to wheelchair, lifting legs/arms, positioning/repositioning)	(Chhokar et al., 2005; Cohen et al., 2010; Joseph & Fritz, 2006; Marras, Knapik, Ferguson, 2009)
		Floor (portable) lifts for patient handling/movement; including moving patient to the bathroom	(Cohen et al., 2010)
		Other patient handling/movement equipment if included in the functional program (e.g. sling, lateral transfer devices, stand assist aids)	(Cohen et al., 2010)
Communication/ Monitoring Equipment	Safe delivery of care Efficient delivery of care	Noiseless paging/visual alarms and displays	
		Selection of alarm systems with centralized alarms at nursing stations and other features to reduce noise in patient rooms	
		Telemedicine connections	
	Improved communication	Visible and legible communication systems (such as patient room boards) to provide care team information to patients and families	
		Easily accessible communication system (e.g. telephone, intercom) for staff between patient room and other healthcare spaces (e.g. nursing station)	
	Reduced patient stress, pain, anxiety, delirium Improved comfort	Minimum noise sources in/around patient room (e.g. bedside phone)	(Bihari et al., 2012; Buxton et al., 2012; Elliott, McKinley & Eager, 2010; Freedman, Gazendam, Levan, Pack, & Schwab, 2001; Tembo & Parker, 2009)
		Elimination or reduction of noise sources (e.g. alarms, pagers, hands free communication etc.)	(Joseph & Ulrich, 2007; Stanchina, Abu-Hijleh, Chaudhry, Carlisle, & Millman, 2005; Xie, Kang, & Mills, 2009)
	Improved family presence and engagement in patient care	Wireless connectivity/ cellphone access	
	Enhanced security	Caregiver control over computer screen to allow private entering of information (to protect electronic medical record [EMR] from being viewed by other patients and unrelated staff) as well as sharing of information with patient (when needed)	
	Change readiness/future-proofing	Coordination with information technology (IT) and communications experts to plan flexible infrastructure that can adapt to expected future technologies	
Sound-Masking Equipment	Reduced patient stress, pain, anxiety, delirium Improved comfort	Use of white noise/sound masking to reduce disruptions from noise (e.g. white noise machines)	(Stanchina, Abu-Hijleh, Chaudhry, Carlisle, & Millman, 2005; Xie, Kang, & Mills, 2009)
	Enhanced privacy	Technology to filter/mask external noise such as white noise machine; pillow speaker and access to music	(Joseph & Ulrich, 2007)

Design Element:	Desirable Outcome:	Design Strategies:	Reference:
Privacy Curtain	Reduced risk of contamination	Privacy curtains that can be cleaned and disinfected (e.g. waterproof shower curtains) or are dispensable	
		Clips or handles used on privacy curtains to minimize contact area that should be cleaned and disinfected	
		Curtains that can be easily removed for cleaning and re-installed	
		Wipe-able/washable, easy-to-clean/ disinfect High Touch Surfaces with minimal joints/seams in the room	(Carling, Briggs, Hylander, & Perkins, 2006; Carling, Briggs, Perkins, & Highlander, 2006; Carling, Parry, & Von Beheren, 2008; Dancer, White, Lamb, Girvan, & Robertson, 2009; Joseph, & Rashid, 2007; Lankford et al., 2007; Takai et al., 2002; Wilson & Ridgway, 2006)
	Reduced patient stress, pain, anxiety, delirium Improved patient satisfaction	Non-glare finishes	
		Non-institutional looking finish materials (e.g. subtle/soft contemporary color, texture variety)	(Altringer, 2010; Becker & Douglass, 2008; Swan, Richardson, & Hutton, 2003)
	Reduced noise	Minimal noise from equipment operation (e.g. curtain track)	
	Enhanced privacy	Minimum perceived visibility from corridor or public areas: caregiver can see the patient in a manner that protects patient's privacy	
	Enhanced durability	Materials that can prevent the growth of mildew and mold due to moisture retention	(Sehulster et al., 2003)
		Materials with high lifecycle performance: minimum wear and tear over time; sustaining recommended cleaning protocols	(Sehulster et al., 2003)
	Improved air quality	Minimum emissions of volatile organic compounds (VOCs)	
		Materials that meet guidelines laid out in Green Guide for Healthcare 2007; and Leadership in Energy & Environmental Design (LEED) for Healthcare Indoor Environmental Quality (IEQ)	
		Minimum need for surface coating and aerosol spray cleaners	
		Low toxicity of materials used	