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Brief Report

Physical distancing for care delivery in health care settings: Considerations and consequences

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As health care systems explore new ways of delivering care for patients with and without COVID-19, they must consider how to maintain physical distancing among health care workers and patients. Physical distancing in high complexity systems such as health care is particularly challenging and may benefit from a human factors and systems engineering perspective. We discuss challenges to implementing and maintaining physical distancing in health care settings and present possible solutions from a human factors and systems engineering perspective.

With few evidence-based pharmaceutical interventions approved for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), health care workers (HCWs) and patients need effective and reliable methods to mitigate viral transmission in health care settings. Physical distancing, also known as social distancing, is an effective non-pharmaceutical intervention that involves maintaining a distance in the physical space between individuals to decrease viral transmission.[1] Public health agencies currently recommend a physical distance of 2 m (6 feet) to decrease SARS-CoV-2 spread.[1,2] There is growing acknowledgment that SARS-CoV-2 aerosols can also spread via the airborne route in some circumstances, and in those situations, physical distancing of more than 2 m may be warranted.[2] In health care settings, while physical distancing is critical to prevent SARS-CoV-2 transmission,[3] it poses challenges and may produce unanticipated negative consequences. The complexity of health care institutions thus requires a systems approach. Here, we present recommendations to mitigate the negative consequences of physical distancing in health care institutions, using a human factors and systems engineering framework.

SYSTEMS ENGINEERING INITIATIVE FOR PATIENT SAFETY MODEL: PROVIDING CARE UNDER PHYSICAL DISTANCING FOR COVID-19 IN HEALTH CARE SETTINGS

Health care systems are highly intricate sociotechnical environments that function by integrating multiple individuals in the performance of tasks using varied technologies, in delimited physical environments, under specific and often challenging organizational conditions.[4] One example of a human factors and systems engineering approach, the Systems Engineering Initiative for Patient Safety (SEIPS) model of health care work systems (Fig 1), comprehensively incorporates all work system elements (ie, external environment, technology/tools, tasks, organization, and person). The SEIPS model enables the identification of modifiable factors within individual work systems which can affect care processes and outcomes.[5,6] The core human factors principles of the SEIPS model include its systems orientation, person-centeredness, and design-driven improvements.[7] SEIPS is especially well-equipped to understand and adapt health care work systems to physical distancing requirements given its successful application to occupational health and safety and quality improvement initiatives in various care health care settings.[5,6]

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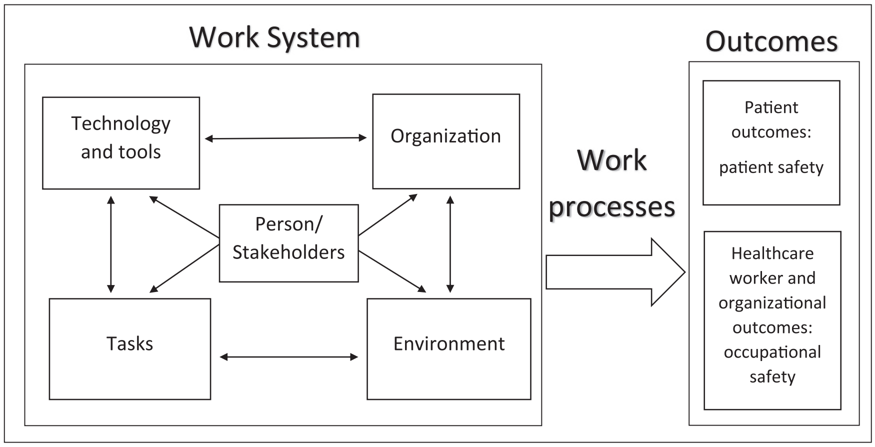

Fig 1. The Systems Engineering Initiative for Patient Safety (SEIPS) model.

Table 1
Challenges to physical distancing between health care workers and patients in health care settings

	Work system elements	Solutions to promote physical distancing	Challenges resulting from physical distancing and potential mitigation
Patient-to-patient and patient-to-health care worker physical distancing	Technology	Increase telemedicine visits; utilize real-time phone interpreters	Care maintenance: Negative health consequences of deferring patient care; missed severity of patient conditions; limits to patient access to HIPAA-compliant video-telehealth technologies; language barrier
	Environment	Triage with physical distancing in Emergency Department; separate patients with suspected respiratory illness into private rooms	Space limitations Mitigation: Construct external triage areas outside of existing hospital structures (eg, triage tents); utilize non-standard spaces (eg, outpatient consultation rooms)
	Environment	Use visual cues (eg, floor markings and spaced seats) to keep persons in common areas 2 meters (6 feet) apart	Space limitations Mitigation: Require limits to and monitoring of the number of persons allowed in common spaces at a time.
	Environment	Externalize equipment (eg, IV pumps) outside COVID-19 patient rooms	Care maintenance: Potential for contamination Mitigation: increased frequency of monitoring equipment and environmental cleaning
	Tasks	Batch care, eg, cohort wards for confirmed or suspected COVID-19 patients	Care maintenance: Lower frequency of contact with patients
	Organization	Reduce in-person physiotherapy/occupational therapy and substitute with video-telehealth sessions	Care maintenance: Loss of vital clinical services potentially decreases long-term health outcomes for non-pandemic related conditions, loss to follow-up of patients, and fragmentation of care. Mitigation: provide remote/ telehealth options (virtual telehealth, asynchronous online training videos)
	Organization	No in-person group sessions, eg, mental health support groups, and substitute with group video-telehealth sessions	Care maintenance: Loss of vital psychological supports Mitigation: increased patient-provider contact through email, voicemail or health care-app check-ins
	Organization	No bedside rounds for inpatients—limit of one medical liaison for patient	Care maintenance: Loss of multi-disciplinary integration of care facilitated by rounds. Mitigation: substitute single rounds with multiple daily updates to patient and care-team
	Person	Have available Airborne Infection Isolation Rooms (AIIRs) for patients undergoing aerosol-generating procedures and/or with pathogens spread by airborne route	Care maintenance Mitigation: In-room videoconference capacity to connect patients to nursing and care providers
	Person	Limit/restrict visitors	Psychological consequences Mitigation: increased accessibility of in-room video-technologies for virtual visits patient support
	Organization	Shut down shared and communal facilities	Psychological consequences Mitigation: increased accessibility of in-room videotechnologies for virtual visits patient support
	Tasks	Perform procedures/tests in patient rooms	Care maintenance: Insufficient portable equipment Mitigation: organizational planning, account for limitations of in-room procedure/test results
	Person	Limit number of entries to patient rooms	Psychological consequences: Providers may feel disconnection from patient when utilizing videotechnologies and virtual visits for ongoing assessment of patient status Mitigation: Promote use of health psychology virtual visits to support mental health

(*continued*)

Table 1 (*Continued*)

	Work system elements	Solutions to promote physical distancing	Challenges resulting from physical distancing and potential mitigation
Health care worker-to-health care worker physical distancing	Environment	Reconfigure workstations in conference rooms to facilitate physical distancing	Care maintenance: Decrease in direct HCW engagement may reduce care integration Mitigation: increased virtual HCW engagement, such as asynchronous learning opportunities through management systems (eg, Canvas); dedicated HCW social media channels on mobile devices (eg, Microsoft Teams)
	Environment	Mark 2-meter distance in shared spaces—eg, break rooms, on-call physician waiting rooms	Space limitations Mitigation: limit number of HCW in different areas
	Organization	Stagger lunch break	Mitigation: Increase availability of no-contact pre-packaged food options, eg, vending machines
	Tasks	Hold virtual rounds	Care maintenance: Reduced care integration Mitigation: split teams into smaller groups with multiple-check-ins
	Organization	Work from home when possible	Psychological consequences: Decreased personnel increases pressure on remaining staff; caregiving requirements may affect HCW availability Mitigation: monitor for signs of HCW burnout
	Organization	Avoid sharing call rooms	Space limitations Mitigation: reallocate office or workspaces as call rooms
	Technologies	Provide specialist tele-consultation options for patients requiring multidisciplinary consultation	Care maintenance Mitigation:

HIPAA, Health Insurance Portability and Accountability Act; *HCW*, health care worker.

In Table 1, we use the SEIPS model is used to identify challenges of physical distancing interventions in health care settings, their potentially negative consequences, and possible mitigation approaches.

DISCUSSION

The rapidly evolving literature on the current COVID-19 pandemic has highlighted that the traditional 6-foot physical distancing recommendation should be interpreted in the context of emerging data on the physics of respiratory emissions.[2,8] The 6-foot distance does not account for the effect on viral particle spread of environmental conditions such as ventilation, airflow patterns or types of activity, or patient specifics (eg, viral load of emitter, duration of exposure, individual susceptibility),[2] nonetheless, keeping a minimum of 6-feet distance is an important strategy among the suite of NPI solutions for preventing SARS-CoV-2 transmission.

Physical distancing falls within 2 tiers of the traditional NIOSH/CDC occupational hierarchy of controls, preventing exposure by eliminating the hazard in some circumstances, and improving administrative controls in others. The SEIPS model provides a framework for integrating physical distancing recommendations in the health care work-system, in Table 1. The model also allows us to identify the range of stakeholders and actors involved in implementing effective physical distancing: health care administrative leadership, clinicians, physical plant, infectious disease teams, and cleaning and environmental control staff. The challenges related to integrating physical distancing recommendations are outlined below.

First is the challenge posed by *space limitations*. This can be mitigated to some degree by the construction of alternative spaces (eg, external tents for ED triage), the reassigning of existing spaces to meet needs (eg, offices for call-rooms), and the cohorting of confirmed COVID-19 patients in shared rooms if necessary.

The second challenge is the *efficient and continued provision of care*. For example, one human factors and systems engineering measure to reduce pandemic exposure involves decreasing the total number of persons frequenting health care settings by postponing nonurgent patient appointments, reducing the numbers of on-site HCW, and restricting visitors. Potential negative consequences of these interventions may impact HCW and patients in all care settings. Outpatients whose care has been deferred may experience deterioration in their medical conditions, while inpatients may experience less attentive and integrated care. The remaining on-site HCW might also be negatively affected by decreases in supportive care, eg, nursing, leading to lowered efficiency.

A third challenge relates to the *psychological consequences* of physical distancing on patients and HCW. Physical isolation can have severe mental health consequences on already ill patients, due to fewer interactions with HCW and visitors in a pandemic. Measures to increase the feasibility of physical distancing in health care settings can also decrease the psychological supports for the remaining HCW, leading to increased stress and burnout.

Many of these challenges can be alleviated by using technology to our advantage within SEIPS work system components (Table 1). Ultimately, all measures and strategies should be evaluated within the context of individual work systems to determine their feasibility. In the context of an evolving pandemic, there is likely to be no "one size fits all" suite of solutions to the challenges of effectively mitigating viral transmission in health care settings. The holistic systems approach of the SEIPS framework is useful to describe the interactions between work system components that are important for integrating physical distancing interventions, maintaining health care delivery, and anticipating potential unwelcome consequences.

CONCLUSION

The COVID-19 pandemic has disrupted health care delivery in an unprecedented manner, the effects of which will be long lasting. Physical distancing will remain an important intervention to mitigate spread of SARS-CoV-2 and potentially other new and emerging respiratory viruses in health care settings for the foreseeable future. A human factors and systems engineering approach, such as through SEIPS, may be helpful to health care institutions in rapidly assessing and deploying physical distancing measures while mitigating its unwelcome effects in health care settings during the COVID-19 pandemic. Future research should examine the impact of physical distancing interventions designed using a human factors and systems engineering approach on patients and HCW outcomes.

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