Discussion Panel
Decedent Handling: Understanding the Challenges and Exploring Opportunities for Ergonomics research

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The COVID-19 pandemic has taken many lives in the last two years. Handling high volumes of decedents within and beyond a hospital's environment has put healthcare- and deathcare-workers at an increased health risk throughout this pandemic. However, systematic research about manual handling of the dead either at the hospital, morgue, funeral home, or in situations of mass fatalities is still in infancy. This session aims to educate ergonomics and safety professionals on the importance of understanding the risk factors associated with handling the decedents, design issues of body bags, effects of PPE, routine versus mass fatality handling of the decedents, and participatory ergonomics. This session will also examine the feasibility of translating the past and current research on the handling of live patients to the handling of patients postmortem. Finally, psychosocial risks due to handling the deceased within the pandemic environment that might influence these workers' risk of musculoskeletal injuries will be deliberated.

Decedent Conditions and Risk of Infection

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In a hospital environment, a patient is declared dead based on irreversibility in the respiratory (e.g., loss of breathing), circulatory (e.g., loss of pulse), and neurological functions (e.g., loss of neuronal activity and reflexes) (Gardiner et al. 2012, Almulhim and Menezes 2021). In this presentation, first, various physiological changes in the patient postmortem are introduced. Second, the risk of infection of the decedent to the healthcare or deathcare worker is explained.

Immediately after somatic death, the muscles of the decedent undergo the relaxation phase (called Primary Muscle Flaccidity) and lose their tone, the eyelids lose their tension, the pupils dilate, the lower jaw falls, and the joints and limbs of the body become flaccid (Raymond 2021). After the primary relaxation, stiffening of the muscles, known as Rigor Mortis, follows. Rigor Mortis occurs due to changes in the muscle physiology when aerobic respiration stops as blood circulation ceases. The joints of the dead body attain a fixed position (or locked in) when the body reaches the maximum rigor. Cessation of the maximum rigidity in the muscles of the decedent after a specific duration leads to relaxation of muscles again, termed as Secondary Muscle Flaccidity, resulting in further decomposition of the body (Raymond 2021, Almulhim and Menezes 2021). Awareness of these time-sensitive postmortem phases, especially primary muscular flaccidity and rigor mortis, is essential for understanding decedent handling because the physiochemical changes in musculature typically develop over the first 12 hours from the onset of death. Also, the hospital staff prepares postmortem care of the decedent during this period, including viewing the body for family, placing the decedent in a body bag, and transferring it to the in-house morgue.

A question often discussed is if there is a potential infection to the healthcare worker when completing the postmortem care compared to the transmission from a

live patient. To this effect, O'Keefe (2021) suggests that no systematic scientific data support the COVID-19 virus's transmission from the decedent to healthcare workers. O'Keefe (2021) further classified the risk of decedent handling during the COVID-19 pandemic (modified from the International Committee of the Red Cross document): low-risk: activities include minimal direct contact with the decedent is involved; medium-risk: activities include log rolling, undressing, or significant manual handling of the decedent, or other low-risk activity that results in unintentional droplet generation; and high-risk: activities include those such as autopsy or other invasive procedures, including embalming and aerosol-generating procedures that could result in direct inhalation of droplets or aerosols or contact with bodily fluids of the deceased and contact with contaminated fomites. This classification will help healthcare and deathcare workers and could be applied for various infectious and pandemic situations (e.g., natural disasters, pandemics).

Body Bags for Decedent Handling

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Bodybags, also known as cadaver pouches or human remains pouches, come in different sizes, weights, colors, and with and without handles. In brief, they are of thick plastic, chlorine-free, impermeable, non-porous, and provide containment of body fluids and bloodborne pathogens. In addition, they are designed with full-length zippers (J- or D-shaped) and can be heat sealed with leak-proof seams. These bags, especially for dealing with infectious decedents, also have additional middle layers and an inner bag that can be heat sealed with leak-proof seams. Finally, some of these bags have multiple bilateral handles for easy lifting. The body bags used for storage during regular operations differ from the types of body bags used in disasters. Appropriately termed, disaster pouches are made of a rugged material that is much tougher than general body bags and are better suited for long-term storage. This presentation addresses the type of body bag and the design issues in terms of coupling, the number of handles, usability in terms of ease of maneuvering the decedent into a body bag, and special scenarios in storing contagious bodies.

Workflow of Decedent Handling in the Hospital Setting: Routine and Mass Fatality

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During the height of the initial surge of COVID-19 in New York in April 2020, workforce safety specialists in Northwell Health, a healthcare system based in New York, collaborated with multiple hospital facilities to organize on-site hazard assessment of decedent handling spaces and work practices. These surveys sought to map the postmortem workflow during routine and mass fatality events as well as identify and mitigate musculoskeletal risks faced by decedent handlers performing the important work of respectfully processing the dead (Lee et al. 2022).

Routine postmortem care of decedents in the hospital setting is a multi-step process requiring multiple handling actions, each of which represents risks for injury to handlers. Generally, decedent handling workflow involves the movement of decedents from one surface to another. Depending on the height disparity between the surfaces, lateral transferring or lifting is necessary. Patients who have expired are cleaned, turned, and repositioned for placement within body bags. Decedents are then transferred laterally onto transport stretchers (referred to as covered cadaver carriers) and transported to the hospital morgue. Subsequent handling actions are variable based on the internal morgue design. Fixed morgues are either walk-in refrigerated rooms or end-opening cooler units where decedents can be stored on telescoping racks or transferred onto rollers. Multi-tiered shelves or body trays in either configuration may be at surface heights that are too high or low for the transport stretcher to accommodate. This design limitation requires raising or lowering the decedent to the appropriate heights (manually or with additional equipment). Decedents released from the hospital are transferred from the aforementioned storage surfaces onto height adjustable gurneys used by funeral directors or medical examiners. For autopsy procedures, the decedent is transferred from the fixed morgue to the procedural surface using the same lifting equipment or techniques used to place the decedent into the morgue. Mobile cadaver stretchers in the walk-in refrigerators are positioned adjacent to the autopsy surface, where a healthcare worker can perform a lateral transfer. Autopsy procedures involve an internal and external examination, which requires turning and positioning of the body (Carpenito et al. 2020).

In March 2020, activation of mass fatality emergency operations throughout the Northwell Health system saw substantial changes to decedent handling practices, conditions, frequency, and attendant risks. Storage was expanded through procurement and the use of external refrigeration in the form of trailers, containers, or trucks known collectively as body collection points (BCP). BCP design and subsequent handling actions were variable between facilities. Given the unprecedented

nature of the ongoing public health crisis and the difficulty in anticipating decedent storage needs, storage was overwhelmingly optimized for capacity, producing unforeseen musculoskeletal stressors for decedent handlers. Initially, bodies were stored on the floor within the BCPs, which required manual lifting to and from stretchers. Many facilities were able to construct temporary shelving within BCPs to expand capacity and minimize the holding of decedents on the floor. However, shelf heights were in some cases constructed too high or low for existing transport equipment requiring manual lifting and lowering until equipment could be procured or lifts modified. Abrasive surface materials such as exposed wood board were quickly discovered to result in body bag tears. Increased forces due to friction against body bag materials during transfers were also a byproduct of the wooden surfaces.

Risk mitigation strategies were implemented during the ongoing public health emergency. Manual lifting and lower to shelves or the floor was addressed by procurement of specialized lifting equipment or modifying existing lifts. Friction-reducing slide sheets were implemented at multiple steps in the workflow where lateral transferring was required. Education and training were provided on new equipment and techniques. Potential improvements identified in initial shelving designs informed the construction of subsequent BCPs and shelves. For example, friction-reducing surfaces such as fiberglass reinforced panels and PVC were part of new shelf construction to reduce strain to handlers while improving sanitization. Front line decedent handlers developed techniques such as tilting gurneys to safely slide decedents to lower shelves and the floor. Best practices during the initial mass fatality surge by decedent handlers also changed routine practices. Facilities took the opportunity to renovate existing internal morgues to decrease manual handling. Close ongoing cooperation between system and site services, including emergency management, safety and security, hospital administration, engineering, front-line decedent handlers, and patient handling and ergonomics specialists, served to improve planning for future mass fatality events.

Participatory Ergonomics Intervention to Prevent Work-related MSDs in Decedent Handling Workers in New York City Health and Hospitals.

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NYC Health + Hospitals is the most extensive municipal healthcare system in the United States, serving 1.4 million patients annually. It operates eleven acute care hospitals, five post-acute care facilities, five nursing homes, six diagnostic and treatment centers, and more than 70 community-based primary care sites. Therefore, we focused on workers exposed to ergonomic hazards in 14 morgues across the health systems – one in each of our hospitals and four in our post-acute care facilities.

The main objective was to create a preventive protocol on work-related MSDs for mortuary workers. This project was triggered by the COVID -19 pandemic, which resulted in a significant increase in fatalities. During a mass fatality incident, the morgue in an acute care hospital may become overwhelmed, exceeding the physical capacity of the morgue. A refrigerated truck may be deployed to serve as a BCP to create additional surge capacity. In New York City, shelving was not allowed in BCPs, which was an important ergonomic consideration. However, navigating the BCPs presents unique ergonomic challenges for workers. To this effect, we developed a guide that will help workers understand how to safely handle decedents when a BCP is required, considering body size, volume, space, and transportation.

We utilized a participatory ergonomics approach for the intervention, with underpinning assumptions that: workers are the experts; and, given appropriate knowledge, skills, tools, facilitation, resources, and encouragement, they are best able to identify and analyze problems and develop, and implement effective ergonomics solutions (Brown 2005, Burgess-Limerick 2018). Participatory focused group meetings were held with multiple stakeholders within the health system to tailor design simulations to assess the ergonomic hazards and create preventive measures. This intervention resulted in a training document that included relevant general ergonomics principles, specifically for lifting, recommendations on equipment, and subsequent uses. A training video was also developed to demonstrate techniques designed to prevent injury that will be easily accessible through the internal human resources system.

Lessons Learned from Safe Patient Handling and Applicability to Handling Decedents

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Relative to handling decedents, the knowledge of risks and best practices for handling live patients is more

broadly established. Much of this knowledge from safe patient handling is applicable to decedent handling. However, lessons learned from patient handling cannot be extended to decedent handling without acknowledging differences in the body, workflow, environment, and work organization. These differences must be carefully considered when leveraging the knowledge of live patient handling to mitigate the risk of injury in decedent handling, at least until the topic of decedent handling receives broader dedicated study and consensus on best practices. From death to the final resting place, processing a decedent can require tasks such as placing and removing body bags or garments, performing an autopsy, embalming, and transporting between locations. Accomplishing these tasks requires turning, repositioning the body on a surface, repositioning limbs, lifting, lateral transfers, and transporting the body on wheeled devices.

Compared to live patients, bodies of decedents have similar weight and mass distributions. However, bodies may be more pliable or far more rigid, as discussed previously in the first section. In addition, degradation of body tissue and loss of fluid, which may be contained in a body bag, could affect contact area and sliding forces compared to a live body. Furthermore, handlers can allow more sudden acceleration or deceleration as there is no concern for causing pain to the body. However, they must still prevent damage to the body and move it with dignity. The staff handling decedents are typically different from the healthcare workers that perform patient handling. Staff moving decedents can include security, orderlies, morgue attendants, and funeral home workers. These workers have different demographics, physical attributes, and training. Their work requirements may allow for less rest or task variety than those of other healthcare workers.

Fortunately, many of the interventions available to reduce the risk of injury in patient handling are applicable to decedent handling. Where workplace and task redesign cannot eliminate risk factors, equipment solutions can reduce the physical stresses on decedent handlers. These technologies include ceiling lifts, mobile lifts, air powered lateral transfer devices, and friction reducing sheets. Additional technology such as a powered lift table can also be considered for handling decedents that might not be appropriate for patients. Powered drives integrated into stretchers can reduce maneuvering forces (e.g., Kotowski et al. 2022, Wiggermann 2017). However, while the interventions named may reduce the physical stresses on workers, interventions such as friction reducing sheets and team lifting do not always sufficiently mitigate the risk of injury based on body weight and work postures adopted (Wiggermann et al. 2021).

Workplace psychosocial risks associated with handling the deceased

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There is growing evidence that workplace psychosocial factors play an important role in the development of MSDs (Buruck et al. 2019, Marcaluso et al. 2020, Yang et al. 2016a). Poor psychosocial factors may lead to adverse psychological responses, such as anxiety, burnout and depression, and physical reactions, including cardiovascular disease, digestive problems, and MSDs (ILO, 2020). The COVID-19 pandemic has caused a surge in handling the deceased in critical healthcare settings. An increased risk of infection due to the COVID-19 pandemic was significantly associated with higher stress and psychological disturbance (Sovold et al., 2021). Psychosocial risks associated with handling decedents in mass fatality events may include long work hours, insufficient recovery time, lack of social support, time pressure due to inadequate staffing, violence, and harassment. Previous studies have linked these psychosocial stressors to pain in the neck and lower back (Yang et al. 2016b), but less so to arms and hands (Sprigg et al. 2007). The complex relationship between psychosocial stressors and MSDs is highlighted by a bidirectional causal relationship between psychological distress and back pain (Paanalahti et al. 2014). Because the psychosocial risk factors for MSDs primarily result from poor work organization, healthy work organization design may minimize adverse responses to psychosocial stressors.

A healthy work organization should consider ergonomic programs for reducing psychosocial risks. Maintain management commitment and employee involvement may empower decedent handlers to mitigate psychosocial risks through proper work organization design. This empowerment establishes an effective communication channel between management and workers to improve workers' ability to adapt work environments physically and psychologically for musculoskeletal health. Risk interventions may include flexible work schedule/workload management, work-family balance, improving job control, and supervisory support (Macaluso et al. 2022, Yang el al. 2017, CAN/CSA Z1003 2013). Also touched on in this

presentation will be organizational factors and cultural considerations in mass fatality events.

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