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2019

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Patient Care in High-Level Containment Care Units

In a Resourced Setting

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An Introduction to the Delivery of Care in Personal Protective Equipment

The ability of experienced clinicians to provide safe care in a high-level containment care (HLCC) unit can be impacted when wearing the advanced personal protective equipment (PPE) that is required when treating individuals with highly hazardous communicable diseases (HHCDs). Caregivers must be aware of the effect that wearing this level of PPE can have on the senses, their ability to communicate effectively, and their inability to sustain their efforts over time as compared to without PPE. Noise from negative air pressure ventilation systems in

the care environment and the use of powered air-purifying respirators (PAPR) may diminish auditory abilities. Visual perception may also be diminished by the limited visual fields of visors, goggles, and face shields. Fine motor skills and tactile sensation may be impeded by the use of two or three layers of gloves. In addition, physical endurance while wearing PPE for an extended period of time may be diminished and varies by health care worker. It is dependent on several factors: baseline level of conditioning, the level of energy expended while in PPE, the individual's threshold for heat tolerance, and any underlying illnesses. Due to these factors, it is desirable that clinicians who will be expected to provide care for patients in the HLCC unit have advanced training that includes performing activities appropriate for their role and skills while wearing PPE. In the event standardized training is not completed prior to an actual event, just-in-time (JIT) training should be provided prior to entering the patient care area to ensure that care providers continue to have some baseline understanding of the challenges of working in PPE.

Clinicians should be instructed on modifications to usual practice that may be required when performing standard patient assessments within the HLCC unit. Access to customary equipment, including stethoscopes, otoscopes, or other devices, may be limited due to infection prevention concerns and the challenges of using such equipment while wearing PPE. The inability to auscultate heart and lung sounds routinely is one of the significant challenges identified by nurses and physicians who have practiced in an HLCC setting. Adjusting assessment techniques to accommodate these restrictions requires flexibility and innovative thinking.

Various adaptive devices are available that can be used to enhance the level of care provided in HLCC units, each with its own unique features and challenges. Electronic and digital stethoscopes with Bluetooth technology have advantages that include sound amplification, the ability to adjust the listening frequency, and the potential use of disposable headphones and headsets for auscultation, allowing the clinician to insert the devices into their ear canals prior to entry into the unit. Disadvantages include increased cost and the need for access to electricity or replacement batteries for charging. Bluetooth stethoscopes may have broadcasting interference, and electronic stethoscopes may

be susceptible to electronic interference by other devices. In addition to the use of specialized auscultation instruments, telehealth equipment can be incorporated to augment head-to-toe assessments. Otoscopes and ophthalmoscopes can be added as options to many telehealth platforms, which allow providers to complete detailed assessments from the “cold” zone of the HLCC unit. This is key to limiting the footprint in the contaminated “hot” zone as much as possible while still providing a standard of care commensurate with or exceeding that in the general inpatient wards.

Telehealth can be a significant component in operating an HLCC unit. In addition to enhancing assessment capabilities, it bridges a noteworthy communication gap. Telehealth products can allow the health care staff to communicate with the patient from the clean area using both audio and video technology to enrich communication. Telehealth products can also be used to allow the patient to communicate with their identified support system, including family and friends. In an isolation care setting all efforts should be made to allow the patient to communicate safely and freely with their loved ones.

The addition of any technology can mitigate some of the challenges encountered when wearing advanced PPE, but the inclusion of these devices for HLCC must include a risk assessment that weighs the potential advantages and barriers of including the equipment.

Staffing

Nursing Staffing. Identifying team members to provide care in the HLCC setting may present a unique challenge in recruitment due to the perceived risk of working in such a unit. The ability to discern appropriate staff is a quality that should be inherent in the leadership team tasked with creating the staff roster. When determining the minimum standards for job descriptions for HLCC staff, a number of factors should be considered: the size of the overall nursing support staff available in the facility; the type of care expected to be provided in the HLCC unit; the demographics of patients to be admitted; the number of beds available in the HLCC unit; and the availability of additional support staff who can augment the nursing team. These are all essential components to address

when designing a strategy to staff an advanced isolation care area. Once the core team is established, nurse leaders should create a staffing matrix that will guide unit operations during an activation. One consideration in this approach is that there must be flexibility built into the process to account for rapid changes in patient acuity, staff endurance in PPE, and staff availability.

Staffing for the admission of a patient with a pathogen that warrants HLCC differs greatly from staffing a standard inpatient unit. In general, the designated HLCC units across the United States rely on a majority of staff who are otherwise employed in departments elsewhere within the facility. This staffing model requires that nurse managers or program directors implement an on-call or “ghost” schedule to identify staff who are available to respond to an activation at any given time. In addition to maintaining a ready roster of staff, the staffing ratios in an HLCC unit require more resource-heavy models. In a typical intensive care unit, the standard ratio is one nurse to two critically ill patients; in an HLCC setting, US models for a patient admitted with a viral hemorrhagic fever (VHF) can be closer to three nurses to one patient for a 12-hour shift. In addition to these 3 nurses, who are responsible for providing direct patient care, an additional 2 to 3 staff members per shift are included on the schedule to support other activities within the unit, bringing the overall ratio for staff to an average of 5–6 for a census of one patient. An increase in census will create the need for an increase in staff assigned to the care of the patients. As with any patient, the minimum number of staff needed for the team will vary depending on the acuity level of the patients and whether more than one nurse is required to remain at the bedside. This approach to staffing is necessary to account for the various roles needed to maintain function of a closed unit and to accommodate modified shift times due to the limited amount of time that care providers can remain in PPE. The model used in the Nebraska Biocontainment Unit (NBU) incorporates key roles and their designated functions into standard operation procedures (SOPs) that are part of the operational protocols, which include the primary nurse, task nurse, front desk nurse, doffing partner, autoclave operator, and tasker (see table 9.1). Each of these roles rotates in 4-hour increments during a standard 12-hour shift.

Table 9.1 Examples of Staff Roles in a Biocontainment Unit

Primary nurse—registered nurse who serves as the coordinator of patient care between the nurses on each shift, ensuring that all nursing duties and charting requirements are fulfilled.

Task nurse—registered nurse who serves as the liaison at the front desk to assist the nurse in the patient care area in executing needed tasks and physicians' orders.

Front desk nurse/trained observer—registered nurse who answers the phones, coordinates with physicians, and monitors the audio/visual feed from the hot zone in order to ensure adherence to infection prevention and control principles.

Doffing partner—rostered staff member who remains in the warm zone and serves a dual purpose by assisting the care providers exiting the care area with doffing PPE and acting as a courier between the cold zone and the hot zone. This person is in the same level of PPE as the provider in the patient care area and, in the event that additional assistance is needed in the patient care area, can quickly and safely enter the room.

Autoclave operator—rostered staff member who receives the waste from the hot zone and processes it through the autoclave. This team member is donned in PPE that is appropriate for the level of risk associated with the waste being processed.

Tasker—rostered staff member who coordinates communication and acquisition of supplies, serves as the liaison with incident command, and provides coverage for the front desk nurse/trained observer during breaks.

This approach allows care providers wearing the required PPE in the patient care areas to switch out in order to limit heat stress and fatigue.

Physician Staffing. Caring for patients with HHCDs requires a multidisciplinary physician team. In the HLCC setting, physician leaders may include infectious disease as well as critical care specialists. Infectious disease specialists manage antimicrobial therapy, monitor viral loads and other markers of infection, evaluate for secondary infectious processes, and oversee the administration of experimental therapeutic agents. Critical care medicine specialists are an important part of the physician team, since patients with HHCDs are often critically ill and may require mechanical ventilation, vasopressors, and invasive procedures. HLCC units may have different specialists in charge, depending on local preference, needs, and availability.

Other physicians, including those who care for special populations, should be included on the physician team. Recruitment efforts for HLCC units that have the potential to care for pediatric patients should include pediatricians and pediatric intensive care specialists. Obstetricians should also be part of the physician team, in case a pregnant woman and/or patient in labor may require care in the HLCC unit. Nephrology specialists may be needed to care for patients with HHCDs, especially those with VHF, who may develop acute renal failure and require dialysis. Relationships should be established with other physician groups, including surgery, pathology, and emergency medicine, since consultations (either in-person or via telemedicine) may become necessary.

Physicians providing care to patients in an HLCC unit may be unavailable to care for other patients in the hospital/clinic for prolonged periods, so it is important to consider having a backfilling plan for other clinical responsibilities. There is a consensus among many HLCC unit leaders that clinicians in training (fellows, residents, students) should not provide direct care for patients with HHCDs due to excessive risk and the desire to limit the number of individuals entering the patient room. Clinicians in training may be able to participate, observe, and assist with the management of patients remotely or via a telemedicine system.

Cohorting. The decision to cohort patients in the HLCC setting is dependent on several factors, including the number of patients requiring care, the physical structure and capabilities of the HLCC unit, the availability of an adequate number of staff, the clinical characteristics of the disease, the equipment needs of the patient, and many others. The medical director should make any decisions about cohorting in consultation with a multidisciplinary leadership team to ensure that all factors are considered. If the decision is made to cohort individuals in an HLCC unit, attention must be paid to infection prevention and control measures. HLCC unit staff should receive JIT training on how to modify SOPs to include strategies to minimize cross contamination between patients. Every effort should be made to maintain the privacy and dignity of those individuals who are being placed in a semiprivate environment in an HLCC setting.

Bedside Procedures

Medical procedures should be performed at the bedside in the HLCC unit whenever possible, since transporting patients infected with HHCDs to other locations may introduce significant risk of contamination of the hospital facility, as well as potential transmission to others. When considering the provision of bedside procedures in the HLCC unit, it is critical to ensure that experienced physicians are available to perform these procedures. Procedural skills can be assessed by direct consultation with these physicians, since some may not feel comfortable performing invasive procedures in an HLCC setting. Training and drills involving the performance of invasive procedures while in PPE should be part of routine training and preparedness for physicians who will be tasked with performing these procedures in the HLCC unit.

Invasive procedures pose an increased risk to the patient and operator any time they are performed. This is especially true in the HLCC setting when the operator is wearing enhanced PPE and treating patients with HHCDs. PPE can make procedures difficult by limiting visibility, decreasing tactile sensation, and preventing the movement of air and heat from the body, making fog and perspiration major issues. Although many of these procedures are performed alone in standard care environments, it is recommended to have an assistant available in the HLCC environment to increase the safety and efficiency of the procedure. It is critical that the operator and assistant discuss the details and planned sequence of the procedure beforehand. Individuals performing high-risk procedures in high-level isolation environments should consider the use of PAPRs in order to decrease the risk of exposure. However, wearing PAPRs could impair the ability to communicate effectively and could cause eye irritation from the air blowing inside the hood; therefore, the decision on the specific PPE should be based on risk assessment.

Vascular Access. Central venous catheters (CVCs) are necessary to deliver fluid resuscitation, medications, and total parenteral nutrition to critically ill patients. Ultrasound guidance should be utilized, and operators with extensive experience in CVC placement should perform the procedure. In the HLCC unit, it may be necessary to leave a CVC in place longer than the standard practice in order to decrease the risk

of a needle stick exposure by eliminating the need for traditional phlebotomy. CVCs should be placed in the left internal jugular vein using ultrasound guidance, leaving the right internal jugular site available for hemodialysis access if needed. The catheter should be secured to the skin with sutureless adhesive dressings to reduce the chance of needle sticks. Ultrasonography may be used to evaluate for the presence of a pneumothorax and confirm appropriate placement if the operator is experienced in this technique. Alternatively, conventional chest radiographs can be used if available. CVC sites should be monitored frequently for signs of infection, and the site should be maintained with strict attention to infection control practices. Peripherally inserted central catheters (PICCs) may be considered, but placement of a PICC line may be extremely difficult in patients who are severely volume depleted. The use of arterial catheters to monitor blood pressure and obtain arterial blood gases can also be considered for critically ill patients in HLCC settings.

Airway Management. In HLCC settings, it is reasonable to perform elective intubation in patients who have early manifestations of respiratory compromise in order to avoid emergency intubation scenarios. Airway management should be performed by experienced operators due to the increased risk in this setting. Since intubation presents a significant risk of aerosolization, PAPRs should be worn in order to provide the best protection. Rapid sequence induction including neuromuscular blockade while utilizing video laryngoscopy is recommended to reduce the likelihood of exposure to the operator.

Prior to performing intubation in the HLCC setting, staffing should be optimized to include an experienced intensive care nurse or critical care respiratory therapist in the room. In addition to the standard safety measures, if patient condition allows it is helpful to walk through the entire procedure in advance of executing intubation. This helps ensure that all staff are clear on their roles and expectations for assisting in a successful and safe intubation.

Dialysis. Patients admitted to an HLCC unit may require continuous renal replacement therapy (CRRT), or dialysis in severe cases, to manage renal failure and electrolyte disturbances. CRRT is an intervention routinely used in intensive care units to support patients with acute renal failure. The aims of RRT are solute and water removal, correction of

electrolyte abnormalities, and normalization of acid-base disturbances. The benefit to considering the use of CRRT as an alternative approach to conventional hemodialysis in an HLCC unit is that it can be successfully managed at the bedside by critical care nurses and telehealth consultation with nephrologists. Advocates of continuous therapy compared to intermittent techniques claim that there is enhanced hemodynamic stability, superior management of fluid balance, and enhanced clearance of inflammatory mediators. As with any type of hemodialysis, patients in an HLCC unit will require the insertion of a hemodialysis line to enable timely initiation of hemodialysis. As patients with HHCDs may experience large fluid shifts and resultant electrolyte imbalances, planning for the provision of hemodialysis should be considered when creating SOPs and recruiting staff for HLCC units. Similar to what is noted above, appropriate PPE will be needed for central venous access and during aspects of dialysis that may involve potential exposures to blood or body fluids. Because a significant minority of patients with severe VHF manifestations may need renal salvage, HLCC units should ensure appropriate coverage or a method for JIT training for a nephrologist and dialysis technicians.

Other Procedures. Thoracentesis, paracentesis, or lumbar puncture may be required either for diagnostic or therapeutic reasons. As with any invasive procedures, a risk assessment should be completed in advance of implementing any interventions and appropriate PPE worn. It has become standard of care to utilize ultrasound guidance in the performance of many invasive bedside procedures, and when feasible, operators experienced in using ultrasound guidance should be involved.

Bedside Surgery vs. Transport to the Operating Theater. Although it is desirable to perform all procedures at the bedside in the HLCC unit, consideration may be given to the transport of HLCC patients on a case-by-case basis. A careful risk-benefit assessment should be conducted, and should include disease-specific transmission risk, the clinical status of the patient, the urgency of the need for surgical intervention, and the training of the surgical team. These factors should be weighed against the risks to the facility, health care workers, and other patients when considering whether a surgical procedure can be performed safely outside of the HLCC unit.

In order to provide bedside surgery safely in an HLCC unit, prior planning and performing a gap analysis to address the preoperative, intraoperative and postoperative phases is essential. All perioperative phases of care will be provided in the HLCC unit patient care room. Operating room (OR) staff should be involved in the development of all perioperative procedures and planning activities. All facility protocols should be followed with enhancements to maintain staff safety within the HLCC unit. There are many considerations to address for all phases of care when planning for surgical intervention in an HLCC unit.

Preoperative considerations to be addressed when developing surgical procedures include determining what equipment will be required, such as an operating table, back table, patient monitoring equipment, and procedural supplies. Ensure that the room possesses the required facility requirements, such as sufficient lighting, medical gases, and suction capabilities. Remove unnecessary equipment or furnishings from the room as well as covering necessary equipment with clear plastic covers to minimize exposure to the pathogen.

Intraoperative considerations include developing processes that maintain a sterile field, such as how to pass supplies into the room if needed. Attention should be given to utilizing methods that minimize the number of instruments required and include disposable instruments where appropriate. In addition, safer practices to minimize blood loss, such as using cautery rather than a scalpel to make incisions, should be explored. If cautery is not an option, the risk of staff injury can be eliminated or minimized by utilizing rounded rather than pointed scalpels, using tools to pick up sharp instruments or needles, and avoiding hand-to-hand passing of sharps by having a neutral passing zone in which sharps are placed prior to being picked up by another person.

Postoperative considerations to be addressed include the removal, decontamination, and sterilization of surgical instruments and equipment; the removal of both liquid and solid waste; and environmental cleanup and decontamination. Staffing for all 3 phases should include experienced OR staff who have been trained in and are knowledgeable about HLCC procedures. When performing surgical procedures within the NBU, during the intra- and postoperative phases PAPER-level PPE

will be worn. During the intraoperative phase, sterile gown and gloves should also be worn over the PAPR-level PPE.

Radiology. The inclusion of X-ray diagnostics to evaluate a patient using portable digital imaging equipment should be considered when providing HLCC. A risk assessment should be completed to evaluate the availability of equipment and properly trained staff when deciding whether to offer X-rays for diagnostics. Radiology technologists who are willing to participate in the care of the patient in the HLCC unit and receive appropriate training in PPE and infection prevention and control (IPC) practices should be selected for the team. The NBU uses a portable X-ray machine and backup battery charger to obtain radiological images. These pieces of equipment are transported into the HLCC unit and stored in a designated clean room inside the NBU once the unit is activated. This equipment then remains within the NBU for the duration of the activation. Once the patient is discharged, or there is no further anticipated use of the X-ray equipment, the same decontamination process is applied to the X-ray machine as with all other equipment in the NBU: manual disinfection using appropriate Environmental Protection Agency (EPA) registered disinfectants and ultraviolet germicidal irradiation (UVGI) treatment.

When establishing the ability to provide X-ray services in an HLCC unit, SOPs should follow established facility protocols for placing orders and contacting designated staff using the existing electronic health record. The designated radiology technologist should utilize the same PPE donning and doffing methods in the unit as the rest of the HLCC staff, including assistance as needed as well as the standard observer system. The portable X-ray machine should be draped in protective plastic covers prior to moving them into the patient care areas.

When the radiology technologist is ready to enter the patient's room, the nurse(s) stationed inside serve to assist by ensuring adherence to safe entry and exit procedures. To minimize the extent of contamination and potential exposures, the radiology technologist should not have direct patient contact. Instead, they will verbally direct the nursing staff to correctly place the digital detector behind the patient for imaging. The digital detector can be contained in a plastic pouch designed for use in

the HLCC unit to limit contamination of the equipment. The radiology technologist is then responsible for positioning the X-ray tube and making the exposure. Once the exposure has been made and the image has been transmitted, the HLCC unit front desk staff contact the radiologist for a preliminary reading. Once receipt of the image is confirmed and a preliminary report has been given, the radiology technologist can exit the patient care areas. The portable X-ray machine undergoes gross decontamination on exiting the patient care area hot zone and prior to placing it in the designated equipment holding area.

It should also be noted that the staff inside of the patient's room do not necessarily need to wear a lead apron when performing these X-rays. In order to reduce the amount of equipment needing decontamination and reduce risk of exposure from scatter radiation, the staff should remain at least 6 feet from the patient during X-ray exposure. If this is not feasible in the patient care area, additional risk assessments should be conducted to determine the safest procedures for the care space. In the event the patient is pregnant, a risk-benefit assessment should be performed by a perinatologist prior to the procedure. A dosimeter stick should also be placed on the portable X-ray machine to track the dose of each exposure.

Recovery Care

Patients in the convalescent stage of their illness require continued care during the recovery process. Patients in this stage should be monitored closely for development of secondary complications of the disease, medication reactions, and health care-associated infections. Depending on the disease, patients may require viral load monitoring or monitoring of other laboratory parameters during recovery. Physical therapy and occupational therapy may be engaged via telemedicine to assist the patient in recovery of their functional status. Attempts should be made to engage the patient in their recovery process and facilitate return to functional capacity, as feasible. Patients can assist with planning their daily schedule, participate in games or other activities, exercise, choose diet preferences, and visit with friends, family, and clergy via video technology.

Discharge and Follow-up

Discharge planning will vary depending on the disease process. In the United States, the Centers for Disease Control and Prevention (CDC), along with state and local public health authorities, should be consulted for guidance regarding criteria for discharge of patients with HHCDs. Based on these recommendations, the patient should be counseled about any necessary lifestyle modifications, including when it is safe to resume sexual activity, because some HHCDs may persist in body fluids for prolonged periods of time, despite recovery. General discharge discussions, including necessary medications, signs and symptoms to monitor for, and the scheduling of follow-up care should also occur. Prior to discharge, the HLCC physician team should communicate with any physicians who will be involved in follow-up care of the patient in order to provide clinical information and answer questions. Discharge planning should always include a case manager, who can provide assistance with transportation and coordinate follow-up care.

Behavioral Health Support

Patients treated in HLCC units are at risk for psychological distress, including symptoms of anxiety and depression. These reactions are due, in part, to the nature of the infection control procedures themselves. Reduced sensory stimulation, loss of control, limitations in social contact, and few meaningful activities may all contribute to the negative psychological consequences of treatment on an HLCC unit. Although there are no controlled studies of interventions designed to mitigate psychological distress in patients treated on such units, the qualitative-phenomenological literature, in connection with clinical experience, suggests a variety of strategies regarding the physical environment, staff-patient interaction, and patient autonomy, as summarized below.

Patient rooms should have a clock, calendar, windows (ideally with exterior views as well as onto the unit), artwork (such as nature scenes), games, reading material, exercise equipment, and shelving for personal belongings, including pictures from home. A telephone, television, com-

puter/tablet, and internet access are vital for maintaining a connection to the outside world. In addition, when not medically contraindicated, patients should be allowed to keep snacks in their rooms rather than depending on staff for all meals.

Staff members should display identifying information outside their PPE by, for example, writing names across their gowns. Staff photographs and short biographical sketches, on paper or the web, could also be provided. It is recommended that all staff be educated on the psychological risks of isolation and strategies to mitigate such risks, including encouraging patients to express concerns, asking clarifying questions, and conveying understanding and empathy. Clear, consistent communication about infection control precautions and the reasons for their implementation is also essential, as patients may have trouble processing such information due to psychological and physical stress. In addition, instructions on infection control practices, as well as possible psychological reactions and recommended coping techniques, should be provided in written, verbal, and video-based formats to accommodate different learning styles. Providing ample opportunity for patients to ask (and to repeat) questions is critical. Professional interpreters should be consulted when necessary.

To combat feelings of helplessness and loss of control, staff should encourage patients to express preferences regarding visitors, the daily schedule, meals, lights/blinds, clothing, religious practices, and recreational activities (a small budget to purchase preferred supplies and reading materials is recommended). Staff should also allow patients to plan some uninterrupted time. Maximizing contact with family (through a secure audiovisual connection if necessary), consistent with patient wishes, is also critical. Accordingly, the hospital might consider designating a gathering space for family adjacent to the HLCC unit.

A behavioral health provider should screen all patients for preexisting and new-onset mental health conditions. The behavioral health provider can use psychological first aid (PFA) to assist patients with problem-solving, accessing social supports, and coping with treatment in the HLCC unit. PFA is a technique designed to reduce the occurrence of posttraumatic stress disorder, delivered by behavioral health specialists or trained health providers, who offer acute assistance to those affected

as part of an organized response effort. Patients with acute stress and adjustment disorders due to traumatic deployments and/or the symptoms of the infectious disease may require ongoing treatment, including referral for medication.

HLCC unit personnel may be dealing with their own stressors, such as fear of infection, ostracism of their children at schools, and avoidance behaviors by friends and family members due to fear of contagion. Therefore, a behavioral health provider should also support the HLCC care team by fostering wellness and resilience prior to, during, and after unit activation.

Among children and adolescents, the above strategies must be adapted to an appropriate developmental level, and should include queries enabling an assessment of their understanding of the treatment and correcting misconceptions (e.g., the isolation precautions are a punishment); limiting and discussing exposure to media coverage of the infection; introducing hands-on activities to facilitate processing of feelings (e.g., playing, drawing); creating daily routines, including time for schoolwork; providing age-appropriate toys/crafts and child-friendly decor; finding ways for children to participate in their own care; encouraging parents to convey confidence in the HLCC staff; and, perhaps most importantly, maximizing contact with family and ensuring that it is predictable.

Family members of HLCC patients are subject to a broad range of emotional and economic stressors. Strategies to reduce family stress are essential to providing holistic care. Strategies include providing regular updates, especially when family members are away from the hospital; sharing information about normal family reactions, including fear of developing the illness; reminding families to use available social supports; cautioning about use of social media when the HLCC activation is covered by the press; and suggesting concrete activities for young family members to help their loved one (e.g., drawing a picture to decorate the hospital room). Facilities can also consider designating or employing a concierge nurse to assist with transportation, lodging, meals, patient contact, spiritual/religious needs, and regular contact with the medical team.