|  |  |  |  |
| --- | --- | --- | --- |
| Table S1. Definition of probability and severity scores | | | |
|  |  | Score | Description |
| Probability | |  |  |
|  | Remote | 1 | Unlikely to occur (may not happen) |
|  | Uncommon | 2 | Possible occurrence (possibly happen once during the event) |
|  | Occasional | 3 | Probably will occur (may happen once a day) |
|  | Frequent | 4 | Likely to occur within a short period (may happen several times a day) |
| Severity | |  |  |
|  | Minor | 1 | No injury, no increased length of stay, nor increased level of care |
|  | Moderate | 2 | Increased length of stay or increased level of care |
|  | Major | 3 | Permanent lessening of bodily functioning (sensory, motor, physiologic, or intellectual) |
|  | Catastrophic | 4 | Death or major permanent loss of function (sensory, motor, physiologic, or intellectual) |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table S2. Failure modes and assessment with HFMEA decision tree | | | | | | | | | | |
| Process and Sub-process | | Failure Mode | | Severity | Probability | Hazard Score | Single-point weakness | Existing Control Measure | Detectable | Validated Failure Mode |
| 1. Identification of patient with injury/illness | | | |  |  |  |  |  |  |  |
| 1A | Patient is identified by bystander | 1A1 | There is no one around a patient | 4 | 2.04 | 8.16 | → | N | N | Yes |
|  |  | 1A2 | Patient is not recognized as a patient | 3 | 1.42 | 4.27 | Y | N | N | Yes |
| 1B | Bystander identifies first aiders | 1B1 | Sign of "First Aider" is not recognized | 2 | 1.02 | 2.04 | N |  |  |  |
|  |  | 1B2 | There are no first aiders around bystander | 3 | 2.18 | 6.55 | Y | Y |  |  |
| 1C | Bystander makes a contact with first aiders | 1C1 | Bystander does not call first aiders | 2 | 1.21 | 2.41 | Y | N | N | Yes |
|  |  | 1C2 | Bystander does not know how to call first aiders | 2 | 2.87 | 5.74 | Y | Y |  |  |
|  |  | 1C3 | Bystander cannot call first aiders (no communication device) | 2 | 2.87 | 5.74 | Y | Y |  |  |
|  |  | 1C4 | Bystander cannot communicate with first aiders | 2 | 3.06 | 6.12 | N |  |  |  |
| 1D | First aiders identify injury/illness | 1D1 | First aiders cannot recognize injury/illness due to lack of skills | 3 | 2.04 | 6.12 | Y | Y |  |  |
|  |  | 1D2 | First aiders cannot recognize injury/illness due to lack of patient cooperation | 1 | 1.66 | 1.66 | N |  |  |  |
| 2. Assessment of severity by first aiders | | | |  |  |  |  |  |  |  |
| 2A | First aiders recognize cardiac arrest | 2A1 | First aiders cannot recognize cardiac arrest | 2 | 1.90 | 3.79 | Y | Y |  |  |
|  |  | 2A2 | Scene cannot be secured | 3 | 1.80 | 5.40 | N |  |  |  |
| 2B | First aiders correctly classify severity (green, yellow, and red) | 2B1 | First aiders cannot observe patient appropriately | 2 | 1.66 | 3.32 | Y | Y |  |  |
|  |  | 2B2 | First aiders cannot determine appropriate severity based on findings | 2 | 1.80 | 3.60 | Y | Y |  |  |
|  |  | 2B3 | First aiders do not continue observation | 2 | 1.17 | 2.34 | N |  |  |  |
| 3. Gathering appropriate medical team | | | |  |  |  |  |  |  |  |
| 3A | First aiders call appropriate medical team (green, yellow, red, and CPA) | 3A1 | First aiders cannot call medical team (no communication device) | 1 | 1.33 | 1.33 | N |  |  |  |
|  |  | 3A2 | First aiders call inappropriate medical team | 1 | 1.02 | 1.02 | N |  |  |  |
|  |  | 3A3 | First aiders do not update severity | 2 | 1.93 | 3.85 | N |  |  |  |
| 3B | First aiders send patient with green code to onsite clinic | 3B1 | Patient gets lost | 1 | 2.35 | 2.35 | N |  |  |  |
|  |  | 3B2 | Patient is sent to wrong place | 1 | 1.66 | 1.66 | N |  |  |  |
|  |  | 3B3 | First aiders cannot communicate with patient | 1 | 2.82 | 2.82 | N |  |  |  |
| 3C | Appropriate team responds to first aiders | 3C1 | Medical team is not available | 2 | 1.62 | 3.25 | Y | N | Y |  |
|  |  | 3C2 | Medical team misrecognize severity | 3 | 1.47 | 4.42 | Y | Y |  |  |
|  |  | 3C3 | Medical team cannot communicate with first aiders | 2 | 1.93 | 3.85 | Y | N | Y |  |
|  |  | 3C4 | Medical team gets lost | 2 | 1.47 | 2.95 | Y | Y |  |  |
| 3D | Medical team brings appropriate medical supply | 3D1 | Enough medical supplies are not available | 2 | 1.31 | 2.63 | Y | Y |  |  |
|  |  | 3D2 | Medical team bring inappropriate medical supplies | 2 | 1.02 | 2.04 | Y | Y |  |  |
| 4. Providing first aid | | | |  |  |  |  |  |  |  |
| 4A | First aiders perform standard precaution | 4A1 | PPE is not available | 2 | 1.02 | 2.04 | Y | Y |  |  |
|  |  | 4A2 | First aiders do not know how to wear PPE | 1 | 1.02 | 1.02 | N |  |  |  |
| 4B | First aiders initiate chest compression | 4B1 | Patient cannot be placed supine | 4 | 1.64 | 6.55 | Y | N | Y |  |
|  |  | 4B2 | Chest compression is not provided appropriately | 4 | 1.47 | 5.89 | Y | Y |  |  |
|  |  | 4B3 | High-quality chest compression cannot be maintained | 2 | 1.47 | 2.95 | Y | Y |  |  |
| 4C | First aiders secure the airway | 4C1 | Airway cannot be secured | 2 | 1.47 | 2.95 | Y | Y |  |  |
| 4D | Active bleeding is conrolled | 4D1 | Bleeding site is not recognized | 3 | 1.59 | 4.77 | Y | Y |  |  |
|  |  | 4D2 | Medical supplies for temporal hemostasis are not available | 2 | 1.64 | 3.27 | Y | Y |  |  |
|  |  | 4D3 | First aiders do not know how to control bleeding | 3 | 1.82 | 5.46 | Y | Y |  |  |
| 4E | First aiders initiate body temperature management | 4E1 | First aiders do not know candidate for temperature management | 1 | 1.33 | 1.33 | N |  |  |  |
|  |  | 4E2 | First aiders do not know how to manage body temperature | 1 | 1.02 | 1.02 | N |  |  |  |
|  |  | 4E3 | Medical supplies for body temperature management are not available | 1 | 1.33 | 1.33 | N |  |  |  |
| 4F | First aiders prevent inappropriate treatment driven by patients | 4F1 | First aiders do not recognize inappropriate treatment | 2 | 1.93 | 3.85 | Y | N | Y |  |
|  |  | 4F2 | Inappropriate treatment continues due to lack of patient cooperation | 2 | 2.02 | 4.04 | Y | N | Y |  |
| 5. Initiation of immediate care by dispatched median team | | | |  |  |  |  |  |  |  |
| 5A | Medical team assesses requirement of immediate care | 5A1 | Medical team cannot assess requirement of immediate care due to lack of knowledge | 4 | 2.18 | 8.74 | → | N | N | Yes |
|  |  | 5A2 | Medical supplies for assessment are not available | 1 | 1.33 | 1.33 | N |  |  |  |
| 5B | Space for immediate care is secured | 5B1 | Place is not physiologically secured | 1 | 2.27 | 2.27 | Y | Y |  |  |
|  |  | 5B2 | Safety is concerned | 4 | 1.37 | 5.48 | Y | Y |  |  |
| 5C | Security team is assembled as needed | 5C1 | Requirement for security team is misrecognized | 1 | 1.47 | 1.47 | N |  |  |  |
|  |  | 5C2 | Medical team cannot call security team (no communication device) | 1 | 1.02 | 1.02 | N |  |  |  |
|  |  | 5C3 | Security team is not available | 1 | 1.82 | 1.82 | N |  |  |  |
| 5D | Medical team provides appropriate immediate care | 5D1 | Appropriate immediate care is not selected due to lack of knowledge | 4 | 1.40 | 5.61 | Y | Y |  |  |
|  |  | 5D2 | Immediate care is not provided appropriately due to lack of skills | 4 | 2.00 | 8.00 | → | N | N | Yes |
|  |  | 5D3 | Medical supplies for immediate care are not available | 3 | 1.82 | 5.46 | Y | Y |  |  |
| 5E | Medical team gathers information regarding patient | 5E1 | Medical team does not know which information should be gathered | 1 | 2.09 | 2.09 | N |  |  |  |
|  |  | 5E2 | No one has information regarding patient | 1 | 2.53 | 2.53 | N |  |  |  |
|  |  | 5E3 | Information cannot be gathered due to miscommunication | 1 | 2.27 | 2.27 | N |  |  |  |
| 5F | Medical team responds to relatives of patient | 5F1 | Medical team does not recognize relatives | 1 | 1.90 | 1.90 | N |  |  |  |
|  |  | 5F2 | Medical team cannot respond due to lack of medical supplies | 1 | 1.82 | 1.82 | N |  |  |  |
|  |  | 5F3 | Medical team cannot respond due to miscommunication with relatives | 1 | 2.23 | 2.23 | N |  |  |  |
| 6. Bowl extrication | | | |  |  |  |  |  |  |  |
| 6A | Medical team knows details of gear for extrication | 6A1 | Medical team does not know kinds of gear | 2 | 1.47 | 2.95 | Y | Y |  |  |
|  |  | 6A2 | Gear for extrication is not available | 2 | 1.18 | 2.37 | Y | N | Y |  |
| 6B | Medical team recognizes capability of patient (walk, wheelchair, or stretcher) | 6B1 | Medical team cannot assess capability due to lack of knowledge | 2 | 2.09 | 4.18 | N |  |  |  |
| 6C | Medical team selects appropriate gear | 6C1 | Medical team cannot select appropriate gear due to lack of knowledge regarding gear | 2 | 2.53 | 5.07 | N |  |  |  |
| 6D | Medical team uses selected gear appropriately | 6D1 | Medical team cannot use gear due to lack of knowledge | 2 | 1.84 | 3.67 | Y | Y |  |  |
|  |  | 6D2 | Medical team cannot use gear due to lack of skills | 2 | 1.64 | 3.27 | Y | Y |  |  |
|  |  | 6D3 | Gear is broken | 2 | 1.49 | 2.99 | Y | N | Y |  |
| 6E | Medical team performs bowl extrication | 6E1 | Enough medical staff is not available | 2 | 1.95 | 3.89 | Y | Y |  |  |
|  |  | 6E2 | Medical team does not know route for bowl extrication | 2 | 1.16 | 2.33 | Y | Y |  |  |
|  |  | 6E3 | Medical team takes patient to wrong place | 2 | 1.33 | 2.66 | Y | Y |  |  |
| 7. Providing continuous medical care at medical suite | | | |  |  |  |  |  |  |  |
| 7A | Medical suite is prepared appropriately | 7A1 | Appropriate space is not available at medical suite | 1 | 2.04 | 2.04 | Y | Y |  |  |
|  |  | 7A2 | Medical supplies are not available at medical suite | 2 | 1.66 | 3.31 | Y | Y |  |  |
|  |  | 7A3 | Space for relatives of patient to wait is not available | 1 | 2.19 | 2.19 | N |  |  |  |
| 7B | Appropriate members are assembled at medical suite | 7B1 | There is no system to assemble members | 2 | 1.33 | 2.66 | N |  |  |  |
|  |  | 7B2 | Communication device to assemble members is not available | 2 | 1.18 | 2.37 | N |  |  |  |
|  |  | 7B3 | Medical staff is not available | 2 | 1.84 | 3.68 | Y | Y |  |  |
| 7C | Dispatched medical team does hand-off to staff at medical suite | 7C1 | Medical team cannot do hand-off due to lack of knowledge | 1 | 2.34 | 2.34 | N |  |  |  |
|  |  | 7C2 | Medical team cannot do hand-off due to miscommunication | 1 | 2.19 | 2.19 | N |  |  |  |
|  |  | 7C3 | Hand-off is conducted at inappropriate timing | 1 | 3.21 | 3.21 | N |  |  |  |
| 7D | Patient is moved on the bed at medical suite from transferring gear | 7D1 | Bed is not available | 1 | 2.20 | 2.20 | N |  |  |  |
|  |  | 7D2 | Patient is not moved appropriately due to lack of skills | 2 | 1.93 | 3.86 | Y | Y |  |  |
| 7E | Continuous care is provided appropriately | 7E1 | Continuous care is not provided appropriately due to lack of knowledge | 3 | 1.64 | 4.91 | Y | Y |  |  |
|  |  | 7E2 | Continuous care is not provided appropriately due to lack of enough medical supplies | 3 | 1.49 | 4.48 | Y | Y |  |  |
|  |  | 7E3 | Patient/relatives reject receiving continuous care | 2 | 2.05 | 4.10 | N |  |  |  |
| 7F | Patient is appropriately packaged for transfer | 7F1 | Patient is not appropriately packaged due to lack of knowledge | 2 | 1.82 | 3.64 | Y | Y |  |  |
|  |  | 7F2 | Patient is not appropriately packaged due to lack of skills | 2 | 2.12 | 4.23 | Y | Y |  |  |
| 8. Deciding disposition | | | |  |  |  |  |  |  |  |
| 8A | Requirement of further medical care is assessed | 8A1 | Requirement of further medical care is not assessed due to lack of knowledge | 2 | 2.53 | 5.07 | Y | N | N | Yes |
| 8B | Ambulance is called | 8B1 | Communication device to call ambulance is not available | 4 | 1.02 | 4.08 | Y | Y |  |  |
|  |  | 8B2 | Ambulance is not available | 4 | 2.54 | 10.16 | → | N | Y |  |
|  |  | 8B3 | Ambulance gets lost in the venue | 3 | 2.13 | 6.39 | Y | Y |  |  |
| 8C | Staff at medical suite calls hospital | 8C1 | Communication device to call hospital is not available | 3 | 1.18 | 3.55 | Y | Y |  |  |
|  |  | 8C2 | Staff at medical suite does not know what kind of information should be sent | 2 | 1.78 | 3.56 | N |  |  |  |
|  |  | 8C3 | Inappropriate information is sent due to lack of knowledge | 2 | 1.86 | 3.71 | N |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 8D | Relatives of patient are informed | 8D1 | Relatives are not recognized | 1 | 2.5 | 2.50 | N |  |  |  |
|  |  | 8D2 | Relatives cannot be informed due to miscommunication | 1 | 2.7 | 2.68 | N |  |  |  |
| 8E | Patient is instructed appropriately at discharge | 8E1 | Staff at medical suite does not know requirement of instruction | 2 | 2.0 | 3.93 | N |  |  |  |
|  |  | 8E2 | Patient is not instructed appropriately due to lack of knowledge | 2 | 2.2 | 4.37 | N |  |  |  |
|  |  | 8E3 | Patient cannot understand instruction correctly | 2 | 2.2 | 4.37 | N |  |  |  |
|  |  | 8E4 | A letter of reference is not provided to patient | 1 | 2.0 | 2.04 | N |  |  |  |
| 9. Transportation to hospital | | | |  |  |  |  |  |  |  |
| 9A | Patient is loaded on ambulance | 9A1 | Patient's personal items are lost | 1 | 2.0 | 2.04 | N |  |  |  |
|  |  | 9A2 | Medical staff who rides on ambulance with patient is not available | 1 | 2.0 | 1.98 | N |  |  |  |
|  |  | 9A3 | Patient/relatives reject transfer to hospital | 2 | 2.2 | 4.37 | N |  |  |  |
| 9B | Hand-off is provided to EMS | 9B1 | Hand-off is not provided appropriately due to lack of knowledge | 2 | 2.0 | 3.93 | N |  |  |  |
|  |  | 9B2 | Hand-off is not provided appropriately due to miscommunication | 2 | 2.2 | 4.37 | N |  |  |  |
| 9C | Requirement of continuous medical care is assessed | 9C1 | Requirement of continuous care is accidentally not assessed | 3 | 1.7 | 4.95 | Y | N | N | Yes |
|  |  | 9C2 | Requirement of continuous care is not assessed appropriately due to lack of knowledge | 3 | 1.8 | 5.46 | Y | N | N | Yes |
| 9D | Continuous medical care is provided as needed | 9D1 | Medical supplies are not available | 2 | 1.7 | 3.34 | Y | Y |  |  |
|  |  | 9D2 | Continuous medical care is not provided due to lack of skills | 3 | 1.7 | 4.97 | Y | N | N | Yes |
| 9E | Hand-off is provided to physician at hospital | 9E1 | Hand-off is not provided appropriately due to lack of knowledge | 2 | 1.8 | 3.56 | N |  |  |  |
|  |  | 9E2 | Hand-off is not provided appropriately due to miscommunication | 2 | 2.0 | 4.08 | Y | Y |  |  |
|  |  | 9E3 | Hand-off is provided to wrong person | 2 | 1.6 | 3.23 | N |  |  |  |
| 10. Managing information security | | | |  |  |  |  |  |  |  |
| 10A | Patient ID is identified | 10A1 | There is no documented ID | 1 | 2.6 | 2.61 | N |  |  |  |
|  |  | 10A2 | Patient intentionally hides ID | 1 | 2.3 | 2.35 | N |  |  |  |
| 10B | Social background is identified (e.g., VIP) | 10B1 | There is no documented ID | 1 | 2.0 | 2.04 | N |  |  |  |
|  |  | 10B2 | Patient intentionally hides social background | 1 | 2.0 | 2.04 | N |  |  |  |
|  |  | 10B3 | Medical staff cannot recognize patient ID as VIP | 1 | 2.2 | 2.18 | N |  |  |  |
| 10C | Communication with authorized people is appropriately conducted | 10C1 | Communication method is not appropriately selected | 2 | 2.2 | 4.37 | N |  |  |  |
|  |  | 10C2 | Communication cannot be conducted due to language/cultural issue | 2 | 2.7 | 5.36 | N |  |  |  |
| 10D | Information is delivered in a secured way | 10D1 | Privacy is physically violated | 1 | 2.5 | 2.53 | N |  |  |  |
|  |  | 10D2 | Information security is accidentally violated | 1 | 2.2 | 2.18 | N |  |  |  |
|  |  | 10D3 | There is no system for managing information security | 1 | 1.3 | 1.35 | N |  |  |  |
|  |  | 10D4 | Information security is intentionally violated | 1 | 1.6 | 1.64 | N |  |  |  |
| HFMEA = Healthcare Failure Mode and Effect Analysis, N = no, Y = yes, CPA = cardiopulmonary arrest, VIP = very important person | | | | | | | | | | |