## Online Data Supplement

This supplement describes in detail how the Reverse Triage Tool of Leuven [RTTL] software was developed. First, we describe the Critical Interventions [CI] of Kelen, Kraus, and McCarthy1 that were retained without adjustment, then we discuss the reasoning for various CI omissions and last the CIs that were adjusted. Some additional criteria were also drafted.

**Fully retained CI**

The first two CIs, CPR and intubation, are so critical that when a patient is expected to need or continue to need these CIs in the next 72 hours, the patient is closely monitored in an ICU. Also intracranial pressure monitoring (CI #8) and arterial lines (CI #24) are never used outside an intensive care setting. Given these considerations, we decided to exclude all patients admitted to any ICU in building filters for the RTTL. Needless to say, these patients will be too critically ill to be moved or discharged anyway. Because the burn centre of UZ Leuven is classified as an ICU, we also excluded heavily burned patients (CI #7). If the severity of burns is not serious enough to require that a patient remain in the ICU, in the event of an MCI, such patient could be discharged following a multidisciplinary reassessment. Wound care can then potentially be done by home nursing companies. Patients with respiratory insufficiency, who need non-invasive positive pressure ventilation (CI #11), are mostly admitted to our Medical ICU B and therefore are also excluded. When patients are not admitted to the Medical ICU B, non-invasive positive pressure ventilation refers primarily to the use of CPAP masks to reduce sleep apnea, which is not a reason to hold off on a multidisciplinary reassessment for early discharge in the event of an MCI. Lastly, also thrombolytic therapy (CI #12) falls under the exclusion criterion of being admitted to an ICU. When Kelen, Kraus and McCarthy1 published their research, thrombolytic therapy was the gold standard for the treatment of a STEMI, but nowadays, thrombolytic therapy is reserved mostly for treatment of ischemic stroke. As these patients will be admitted to the neurological high-care unit, they are excluded according to the ICU exclusion criterion mentioned above.

Patients who need dialysis (CI #9), are admitted to the nephrology ward. These patients need dialysis but are only admitted to the hospital because of additional problems. Other patients who need dialysis and do not have these additional problems visit the dialysis ward on an ambulant basis and therefore do not occupy beds. The reason we exclude all patients admitted to nephrology wards is because of the high-care burden.

Patients who require psychiatric monitoring (CI #15) are excluded as they are hospitalized in psychiatric units. They are admitted to protect them from harming him or herself or society, and therefore cannot be discharged early.

Women who are about to give birth by vaginal delivery (CI #23) are, by definition, admitted to the delivery room. Therefore, these women are excluded because they are hospitalized in the delivery unit. Mothers who have given birth by vaginal delivery, should be reassessed in a multidisciplinary manner in the event that an MCI occurs on the day of delivery. For this reason, the maternity ward was not retained in construction of the RTTL software. By contrast, the unit where women are monitored for a complicated pregnancy is retained. This is because these patients may need a caesarean section (CI #4) within the next 72 hours. Patients who have undergone a caesarean section, are excluded by their presence in the operating room less than 48 hours prior to the MCI event; this is indicated in the next exclusion criterion.

Kelen, Kraus and McCarthy1 did not further elaborate on the details of CI #14, ‘other invasive procedure’. Therefore, we decided to group all possible invasive procedures according to location: endoscopy, interventional radiology and operating room. If a patient underwent a procedure at one of these locations 48 hours prior to the MCI, regardless of the specific nature of the procedure, that patient is excluded as a candidate for early discharge. As we cannot foresee whether a patient might need an invasive procedure within the next 72 hours post-MCI, we decided to narrow the time window to 48 hours. We reached consensus on the situation in which any patient who had undergone an invasive procedure less than 48 hours before an MCI, would not be eligible for early discharge.

Critical Intervention #16, heart catheterization, is covered by no less than three exclusion criteria. To begin, all catheterizations take place in the interventional radiology centre. All patients who were there for an invasive procedure in the 48 hours prior to an MCI, are excluded by the criterion we just discussed. Subsequently these patients end up being admitted to the coronary care unit [CCU] where they are excluded because they stay in an ICU. Even patients who sign in at the emergency department [ED] with retrosternal chest pain, who potentially need a heart catheterization, are excluded, because they will never be in the ED for longer than 6 hours. This exclusion criterion was not derived from the original CI list, but we added it to the RTTL. Along these same lines, every patient who needs a thoracentesis (CI #17) or a paracentesis (CI #22) will always have been in the interventional radiology unit, and therefore, are excluded by the same reasoning as that explained for using criterion CI #14.
A major surgical procedure or operation (CI #3) has been translated for our purposes in the RTTL as a surgical intervention lasting more than 90 minutes. All patients who need to undergo surgery that takes more than 90 minutes are excluded by this criterion. Moreover, these patients are also excluded by their presence in the operating room less than 48 hours prior to the MCI. The cancellation of elective procedures is also a way of augmenting surge capacity but is a component that stands on its own and is not part of the reverse triage process. Therefore, the RTTL does not take future elective surgeries into account.

Oxygen-dependency (CI #6) is translated into the RTTL if it exceeds a threshold of 5 liters of oxygen per minute. This makes sense, since a patient needing less than 5 liters oxygen per minute, can be safely transferred to another location where bottles of oxygen can be prepositioned for disaster preparedness. Thereby, the CI can continue after the patient is discharged from the hospital and would not be withdrawn. Additionally, if a patient needs more than 5 liters oxygen per minute, then respiratory insufficiency is considered to be large enough to keep him in the hospital in the event of an MCI.

The need for blood transfusion (CI #13) is indicated by the concentration of the patient’s blood haemoglobin. Initially, the haemoglobin threshold of 7 g/dl was chosen to exclude patients from early discharge. However, the IT department faced difficulties trying to integrate this criterion into the Health Electronic Record [HER] of the study hospital. Given that no patient from the random group had such a low haemoglobin concentration, an alternative parameter was sought. Consensus was reached to exclude patients who received a transfusion less than 48 hours prior to the MCI, because the probability of developing a negative outcome, like a transfusion reaction, within the subsequent 72 hours was considered. This parameter could be verified by the registration of blood products administered in the transfusion tool of the HER.

Regarding wound care (CI #18), which again was not further elaborated on by Kelen, Kraus, and McCarthy1, the presence of stage 3 (necrosis of the skin and subcutis) and stage 4 (necrosis affecting the muscles or bones) decubitus wounds were considered as reasons necessitating further admission and treatment. Patients with these wounds are therefore excluded by the RTTL filter.

At the University Hospitals of Leuven, the Katz-scale is used to measure the amount of support needed for the Activities of Daily Living [ADL] (CI #28). It should be noted that this scale is *not* the same as the Katz Index of Independence in Activities of Daily Living2, commonly used in the US. The Katz-scale used in Belgium consists of six physical domains within the ADL (to wash themselves, to dress themselves, to transfer or move themselves, visiting the toilet, continence, and to eat by themselves), each with a possible score ranging from one to four. The higher the score on an item, the greater is the patient’s dependence. Patients are excluded if they score a three or higher on at least one item, indicating that they require partial or complete assistance in that domain.

**Omitted CI**

The need for parenteral nutrition (CI #21) or parenteral pain medication (CI #27) were decided not to be crucial enough to keep these patients in the hospital in the event of a MCI, without a multidisciplinary reassessment. When necessary, parenteral nutrition can be continued at home or at other locations outside the hospital. This reasoning applies also to other ways of administrating pain medication (intramuscular, subcutaneous or transdermal) outside the hospital in disaster situations.

The need for a lumbar puncture (CI #25) is an intervention that we tried to integrate into the HER of the study hospital but was not technically feasible.

**Adjusted CI**

Now we discuss the CIs that were adjusted, because they were covered by already existing exclusion criteria. No new criteria were created for these CIs.

The need for intravenous [IV] administration of medication, fluids or vasopressors (CI #5) is one example of a CI that falls into this adjusted group. First, patients who are administered vasopressors need an arterial line for invasive blood pressure monitoring and therefore need to be cared for in an ICU. So these two already existing exclusion criteria will cover the patients who need IV vasopressor administration. Furthermore, we did not find administration of IV medications or fluids crucial enough to allow these patients to stay in the hospital during a MCI, without a multidisciplinary reassessment of their needs. Many patients still receive an IV maintenance infusion of isotonic fluids the day they are getting discharged by a normal discharge procedure. This will then also be stopped abruptly. The same is true for IV medication, the multidisciplinary discharge team can still decide if the need for IV medication is still great, or if the patient can safely switch to oral treatment.

The potential need for a thoracotomy (CI #10) is another CI that needed to be evaluated for possible adjustment. A consensus was reached that having received a thoracotomy more than 48 hours prior, in combination with lack of a requirement to stay in an ICU, is not crucial enough to let a patient stay in the hospital during an MCI without a proper multidisciplinary reassessment to re-evaluate the necessity of the thoracotomy. On the other hand, patients who need a thoracotomy, will be upgraded in care. Those patients will, therefore, be excluded on the bases of having an intervention less than 48 hours prior to the MCI, as well by their presence in an ICU afterwards.

The need for, or currently having a central line (CI #19), is another CI that his covered in the already existing exclusion criteria. As all central lines are performed in the surgical day centre (ambulant patients) or in the operating rooms (hospitalized patients), these patients were excluded because they are only in the hospital for one day (additional criterion) or were in the operating rooms less than 48 hours before the MCI occurred. When the patient had received a central line sometime in the past (e.g., Port-a-Cath®, Smiths Medical, Zaventem, Belgium) it counts only as a CI when it is being performed contemporaneously with the MCI. If this is the case, the same considerations that applied for CI #5 apply here.

Another adjusted CI is “incision and drainage” (CI #20). Again, this CI missed further clarification and was therefore defined as the presence of a drainage system somewhere in the body, other than the cranium (cerebral bolt) or thorax (thoracotomy). Again, the presence of one or multiple drains is considered insufficiently crucial to exclude a patient from a multidisciplinary reassessment. Nevertheless these patients are excluded when the drain procedure was done in the operating, endoscopy, or interventional radiology rooms less than 48 hours before the MCI.

Cardiac monitoring (CI #26) is the last adjusted CI. The authors found that needing cardiac monitoring is not crucial enough to exclude the patient from a multidisciplinary reassessment during an MCI. Depending on the context of the individual situation of the patient, he or she can go home with a Holter monitor or can be transferred to another location outside the hospital with portable monitoring. If cardiac problems are of such a nature that the likelihood of developing a Consequential Medical Event [CME] within the next 72 hours if cardiac monitoring were to be withdrawn, this patient should stay at a medium care unit or ICU. He then will be excluded by his presence in an ICU.

**Additional criteria**

Besides translation of the 28 CIs of Kelen, Kraus and McCarthy1, some additional criteria were created and integrated into the RTTL software. First, other campuses of the tertiary academic hospital UZ Leuven were excluded because they did not belong to the study population. Next, patients present at the hospital for ambulant investigations or a consultation (and therefore not occupying beds) were also excluded. Also patients admitted for day surgery were excluded, because those beds would be empty after the normal discharge procedure contemporaneous with the unfolding of the MCI. Patients present in the ED for less than 6 hours would also not be occupying beds, and were therefore excluded. The haematological isolation ward and the neonatology unit were also excluded because they care for patients who need specific care. Finally, some patients are admitted to units where they are daily discharged (e.g., sleep laboratory unit), and some units do not represent an actual bed (e.g., the morgue).

The additional table presents an overview of the translation of the 28 CIs of Kelen, Kraus and McCarthy1 into the RTTL.

**References**

1. Kelen GD, Kraus CK, McCarthy ML, et al. Inpatient disposition classification for the creation of hospital surge capacity: a multiphase study. Lancet. 2006;368(9551):1984-1990.
2. Katz S, Downs TD, Cash HR, et al. Progress in development of the index of ADL. Gerontologist. 1970;10:20-30.

**Additional Table: Translation of the original CIs into the RTTL.**

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| **Retained Critical Interventions\*** | **Translation into RTTL** |
| 1 CPR or defibrillation2 Intubation or airway management7 Burn care8 Cerebral bolt11 Non-invasive PPV12 Thrombolytic therapy24 Arterial line | Patient is admitted to the ICU. |
| 9 Dialysis | Patient is admitted at the nephrology-dialysis ward |
| 15 Psychiatric monitoring | Patient is admitted at the acute psychiatry ward |
| 23 Vaginal delivery | Patient is admitted at the* Delivery room
* Complicated pregnancy unit
 |
| 4 Caesarean section14 Other invasive procedure16 Cardiac catheterization17 Thoracocentesis22 Paracentesis | Patient underwent an intervention less than 48 hours ago in the unit prior to the MCI* Endoscopy
* Interventional radiology
* Operating room
 |
| 3 Major surgical procedure or operation | Patient underwent a surgical intervention that took more than 90 minutes |
| 6 Oxygen dependent | Patient needs more than 5 liters of oxygen per minute |
| 13 Transfusion | Patient underwent a transfusion less than 48 hours prior to the MCI |
| 18 Wound care | Patient has a stage 3 or 4 decubitus wound |
| 28 Support for ADL | Patient scores higher than 2 on one of the 6 components of the Katz-scale for ADL |
| **Omitted Critical Interventions\*** | **Adjusted Critical Interventions\*** |
| 21 Parenteral nutrition25 Lumbar puncture27 Parenteral pain medication | 5 Intravenous vasopressors and fluid10 Thoracotomy19 Central line20 Incision and drainage26 Cardiac monitoring |
| **Additions to the RTTL** |
| Patient is admitted at another campus other than the UZ Leuven, Gasthuisberg campus |
| Patient is present at the hospital for an ambulant investigation or consultation |
| Patient is admitted to the hospital for only one day |
| Patient is present at the ED for less than 6 hours |
| Patient is present at the neonatology unit, haematological isolation ward, sleep laboratory unit or morgue |

ADL, Activities of daily life; CME, consequential medical event; CPR, cardiopulmonary resuscitation; PPV, positive pressure ventilation. \* Number to the left of each entry is the original CI identification