Emergency Interventions

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Emergency intervention included in this brief:
EMRGC03-02 Trauma laparotomy
EMRGC03-03 Tube thoracostomy
EMRGC03-04-01 Using common cure agents for intoxication/poisoning
EMRGC03-05 Acute intracranial pressure relief
EMRGC04-01 Urgent orthopedic management of injuries with, e.g., open reduction and internal fixation
EMRGC04-02 Fracture reduction and placement of external fixator and use of traction for fractures

Emergency interventions not included in this brief:
EMRGC01-01 Basic life support and first aid for burns, bleeding and wounds and choking

EMRGC02-01 Management of non-displaced fractures
EMRGC02-02 Resuscitation with basic life support measures
EMRGC02-03 Triage and stabilization, with referral to hospital of high risk patients (including pregnant women, young children, and those with underlying medical conditions)

EMRGC03-01 Resuscitation with advanced life support measures
EMRGC03-04-02 Early identification of lead poisoning symptoms of children

EMRGC04-03 Irrigation and debridement of open fractures
EMRGC04-04 Management of septic arthritis
EMRGC04-05 Trauma-related amputations

Intervention Attributes

Type of intervention

Curative

Delivery platform

The emergency trauma care interventions are delivered at first-level hospitals with capable emergency services. Some complex procedures may take place at referral hospitals.

Equity

In addition to considerations like cost-effectiveness and health systems factors, dimensions of equity can be relevant for priority setting. The opportunity for a long and healthy life varies according to the severity of a health condition that individuals might have, so there are inequities in individuals' opportunities for long and healthy lives based on the health conditions they face. Metrics used to estimate the severity of illness at an individual level can be used to help prioritize those with less opportunity for lifetime health. FairChoices: DCP Analytics Tool uses Health adjusted age of death (HAAD), which is a metric that estimates the number of years lived from birth to death, discounting years lived with disability. A high HAAD thus represents a disease less severe in terms of lifetime health loss, while a low HAAD represents a disease that is severe on average, causing early death or a long period of severe disability. It is also possible to estimate the distribution of HAAD across individuals with a health condition. FairChoices shows for each intervention an average HAAD value of the conditions that are affected by respective interventions that have health effects. Additionally, a plot shows HAAD values for around 290 conditions (Johansson KA et al 2020).

Time dependence

High level of urgency (emergent)

Literature Evidence

Case Fatality

As described in the section “Approach for Generating Affected Fractions by External Cause”, case fatality estimates were generated from literature and expert opinion for a select group of causes associated with high mortality. Google Scholar and PubMed were employed with the name of the injury. The priority was in finding research from low and middle income settings, but

where no research or only lower-grade research was available, data was used from high-income settings. Most research was descriptive studies either from an individual hospital, or from regional or national data sets; a preference was given to the larger data sets where available. When more than one descriptive study was found to be applicable, the case fatality ratio was taken to be a weighted average with preference given to numbers from low income settings.

The following sources were used for these respective case fatality ratios:

Injury	Case Fatality Ratio	Source
Lower Airway Burns	0.3	Survey of studies from the United States and South Korea (Kim et al.).
Burns, >=20% total burned surface area or >= 10% burned surface area if head/neck or hands/wrist involved w/o lower airway burns	0.2	Survey of studies from the United States and South Korea (Kim et al.).
Fracture of hip	0.246	Surveys of surgery in United States (Kelly et al.) and Sweden ().
Fracture of skull	0.132	
Fracture of vertebral column	0.17	
Fracture of femur, other than femoral neck	0.17	
Moderate/Severe TBI	0.31	
Spinal cord lesion at neck level	0.34	
Spinal cord lesion below neck level	0.06	
Drowning and nonfatal submersion	0.3	
Crush injury	0.2	
Poisoning requiring	0.07	

urgent care		
Severe chest Injury	0.4	
Internal hemorrhage in abdomen and pelvis	0.4	
Multiple fractures, dislocations, crashes, wounds, pains, and strains	0.2	

Intervention Effects on Mortality and Disability

Approach for Generating Affected Fractions by External Cause

Global Burden of Disease 2019 estimates were available for injury incidence by the combination of external cause of injury (e.g. road traffic injuries) and nature of injury (e.g. skull fracture); however, mortality estimates from the GBD were only available for external causes. The general aim was to estimate the proportion of mortality from given external cause that might be addressed by a particular intervention (e.g. acute intracranial pressure relief may apply as an intervention that could avert deaths in X% of cyclist road injuries). To do this, we mapped interventions to injuries by nature, used the GBD incidence estimates by external cause and nature, case fatality estimates from literature and expert opinion, GBD mortality estimates by external cause of injury, and expert-informed decisions about the injuries by nature most closely related to mortality. This process is described below in detail.

We utilized global estimates to calculate affected fractions of GBD mortality by external cause for each intervention (e.g. acute intracranial pressure relief may apply as an intervention that could avert deaths in X% of cyclist road injuries). These calculations could be done in a country-specific manner, though for this exercise, we assumed that the distribution of types of bodily injuries from a particular cause did not vary across countries.

First, we mapped the case fatality estimates described in the section above to the nature of injury categories included in the GBD. We narrowed down the causes that we believed to contribute substantially to mortality. The subset of causes included: lower airway burns; burns with large surface area affected; fractures of the hip, pelvis, skull, vertebral column, or femur; moderate to severe traumatic brain injury; spinal cord lesions; drowning; crush injury; poisoning; severe chest injury; internal hemorrhage in abdomen and pelvis; and multiple fractures, dislocations, crashes, wounds, pains, and strains. The case fatality estimates assumed for each of these is shown in the above section.

Then, we used the incidence estimates from the GBD for the combination of external cause (E) and nature of injury (N), and multiplied the incidence estimate by the case fatality for the relevant nature of injury.

$$Death_{E,N} = Incidence_{E,N} * Case\ Fatality_{N}$$

We summed the resulting deaths across the nature of injury types within an external cause of injury. We then divided the GBD deaths by external cause of injury by this number to obtain a scalar by which to scale-up the deaths by external cause and nature calculated above so that they would be consistent with the GBD death estimates.

$$Adjusted\ Deaths_{E,N} = \frac{GBD\ Death\ Estimate_{E}}{\sum_{N=1}^{n} Deaths_{E,N}} * Deaths_{E,N}$$

For many GBD causes, there were small fractions of total deaths from types of injuries that would be unlikely to contribute substantially to death (e.g. in GBD, there are non-zero incident traumatic brain injuries from venomous animal contact, but by far and away most deaths from venomous animal contact come as a result of poisonings). For simplicity, we excluded nature of injury categories accounting for less than 5% of deaths and then rescaled again using the above equation.

Interventions were mapped to nature of injury categories, so we then had estimates of the fraction of deaths from an external cause of injury that were from nature of injury categories with relevant interventions. So, for instance, we mapped acute intracranial pressure relief to fracture of the skull and moderate/severe traumatic brain injury. We estimated that X% of cyclist road injuries resulted in deaths from fracture of the skull or moderate/severe traumatic brain injury. For the acute intracranial pressure relief intervention, we then assumed that it had the potential to affect X% of cyclist road injury deaths (the affected fraction used in FairChoices).

This proportion of deaths from cyclist road injuries would then be multiplied by the estimated effect size of acute intracranial pressure relief among people with these injuries (effect size estimates described in the section above). There were a few injuries with multiple interventions (e.g. some fractures would be addressed by both “Fracture reduction and placement of external fixator and use of traction for fractures” and “Urgent orthopedic management of injuries with e.g. pen reduction and internal fixation.” The effect sizes for these two interventions were reduced so that effects were not duplicated. In other cases of multiple interventions affected one cause from interventions outside of these trauma interventions, FairChoices used the generic approach for combining effects used elsewhere in the tool below (RRR = relative risk reduction for each intervention, i, acting on the same cause of burden).

$$Combined\ Effect = 1 - \prod_{i=1}^{n}(1 - RRR_{i})$$

Model Assumptions

All of the emergency trauma interventions below apply to all ages (0 to 99) and genders in the health impact modeling.

Input Parameter	Input Value
Affected Age	0 to 99
Affected Gender	Both

Table 3: Disease burden affected fraction estimates (methods described above)

Intervention	Cause of Disease Burden	Affected Fraction
Acute intracranial pressure relief	Conflict and terrorism	0.09
	Cyclist road injuries	0.50
	Exposure to forces of nature	0.24
	Falls	0.32
	Foreign body in other body part	0.14
	Motor vehicle road injuries	0.43
	Motorcyclist road injuries	0.63
	Non-venomous animal contact	0.18
	Other exposure to mechanical forces	0.18
	Other road injuries	0.33
	Other transport injuries	0.56
	Other unintentional injuries	0.15
	Pedestrian road injuries	0.57
	Physical violence by firearm	0.21

	Physical violence by other means	0.32
	Physical violence by sharp object	0.07
	Pulmonary aspiration and foreign body in airway	0.19
	Self-harm by firearm	0.31
	Self-harm by other specified means	0.10
	Unintentional firearm injuries	0.14
Fracture reduction and placement of external fixator and use of traction for fractures	Conflict and terrorism	0.10
	Cyclist road injuries	0.14
	Exposure to forces of nature	0.10
	Falls	0.23
	Foreign body in other body part	0.06
	Motor vehicle road injuries	0.12
	Motorcyclist road injuries	0.12
	Non-venomous animal contact	0.07
	Other exposure to mechanical forces	0.12
	Other road injuries	0.15
	Other transport injuries	0.14
	Other unintentional injuries	0.14
	Pedestrian road injuries	0.12
	Physical violence by other means	0.07
	Pulmonary aspiration and foreign body in airway	0.10

	Unintentional firearm injuries	0.08
Trauma laparotomy	Conflict and terrorism	0.36
	Cyclist road injuries	0.34
	Exposure to forces of nature	0.32
	Falls	0.28
	Fire, heat, and hot substances	0.22
	Foreign body in other body part	0.44
	Motor vehicle road injuries	0.30
	Motorcyclist road injuries	0.21
	Non-venomous animal contact	0.36
	Other exposure to mechanical forces	0.44
	Other road injuries	0.35
	Other transport injuries	0.26
	Other unintentional injuries	0.47
	Pedestrian road injuries	0.26
	Physical violence by firearm	0.56
	Physical violence by other means	0.46
	Physical violence by sharp object	0.54
	Pulmonary aspiration and foreign body in airway	0.32
	Self-harm by firearm	0.25
	Unintentional firearm injuries	0.52
Tube thoracostomy	Conflict and terrorism	0.18
	Cyclist road injuries	0.12
	Exposure to forces of nature	0.16

	Falls	0.14
	Fire, heat, and hot substances	0.08
	Foreign body in other body part	0.20
	Motor vehicle road injuries	0.16
	Motorcyclist road injuries	0.10
	Non-venomous animal contact	0.13
	Other exposure to mechanical forces	0.20
	Other road injuries	0.20
	Other transport injuries	0.11
	Other unintentional injuries	0.14
	Pedestrian road injuries	0.12
	Physical violence by firearm	0.23
	Physical violence by other means	0.23
	Physical violence by sharp object	0.40
	Pulmonary aspiration and foreign body in airway	0.14
	Self-harm by firearm	0.18
	Unintentional firearm injuries	0.26
Urgent orthopedic management of injuries with, e.g., open reduction and internal fixation	Conflict and terrorism	0.10
	Cyclist road injuries	0.14
	Exposure to forces of nature	0.10
	Falls	0.23
	Foreign body in other body	0.06

	part	
	Motor vehicle road injuries	0.12
	Motorcyclist road injuries	0.12
	Non-venomous animal contact	0.07
	Other exposure to mechanical forces	0.12
	Other road injuries	0.15
	Other transport injuries	0.14
	Other unintentional injuries	0.14
	Pedestrian road injuries	0.12
	Physical violence by other means	0.07
	Pulmonary aspiration and foreign body in airway	0.10
	Unintentional firearm injuries	0.08
Using common cure agents for intoxication/poisoning	Conflict and terrorism	0.16
	Exposure to forces of nature	0.08
	Fire, heat, and hot substances	0.25
	Foreign body in other body part	0.08
	Non-venomous animal contact	0.36
	Other exposure to mechanical forces	0.04
	Other unintentional injuries	0.12
	Poisoning by carbon monoxide	1.00
	Poisoning by other means	1.00
	Pulmonary aspiration and	0.23

	foreign body in airway	
	Self-harm by firearm	0.19
	Self-harm by other specified means	0.84
	Venomous animal contact	1.00

Table 4: Intervention effect sizes on mortality and disability

Intervention	Relative RIsk Reduction for Mortality	Disability Reduction
Trauma laparotomy	0.5	0.25
Tube thoracostomy	0.4	0.2
Using common cure agents for intoxication/poisoning	0.5	0.5
Acute intracranial pressure relief	0.4	0.2
Fracture reduction and placement of external fixator and use of traction for fractures	0.3	0.1
Urgent orthopedic management of injuries with, e.g., open reduction and internal fixation	0.1	0.3