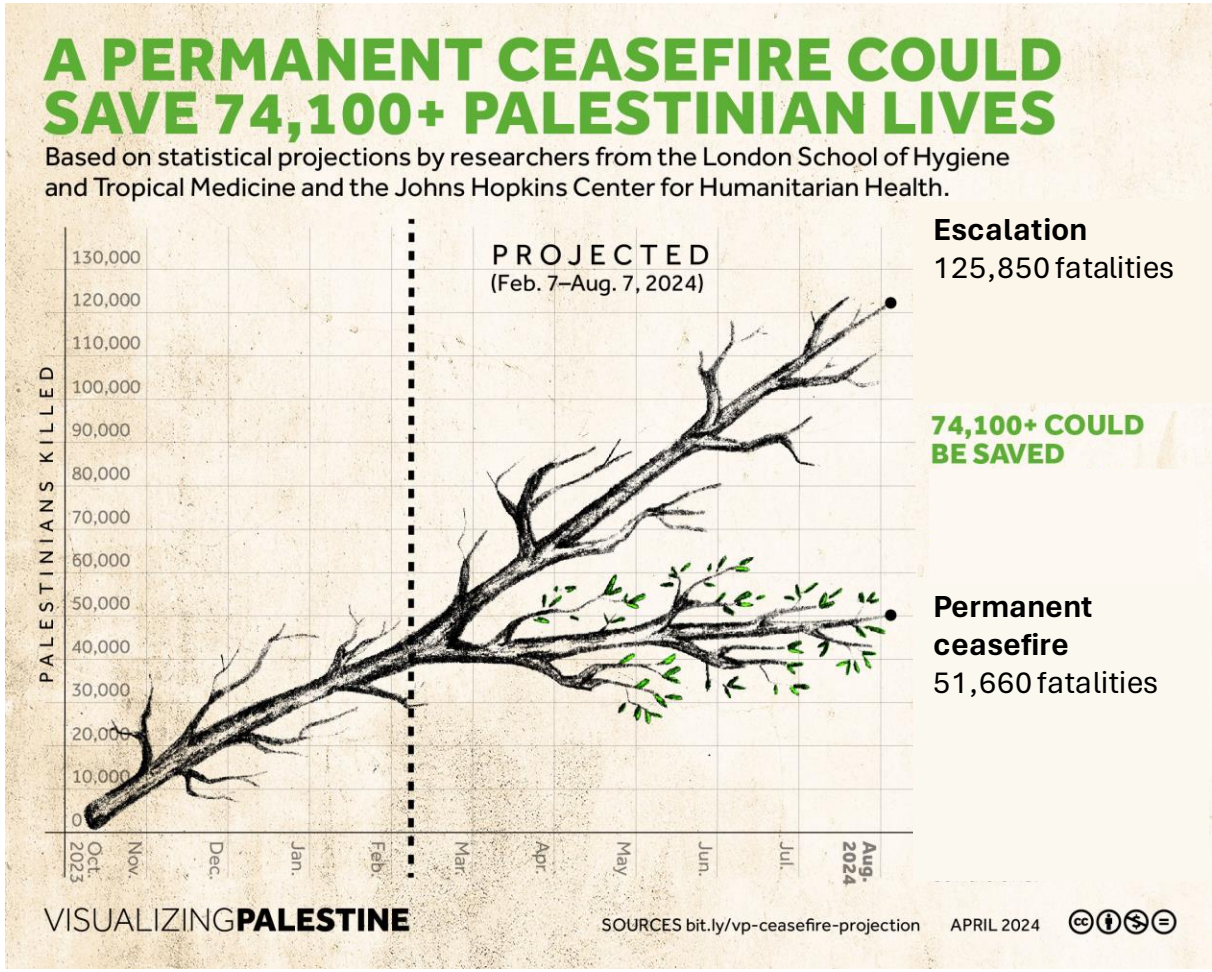

War in Gaza: Scenario-Based Excess Mortality Projections

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Conflict of Interest:
The author has declared no conflict of interest.

About the project

War has multidimensional effects: mortality selected as the most downstream, ultimate indicator of health impact

- Project excess deaths

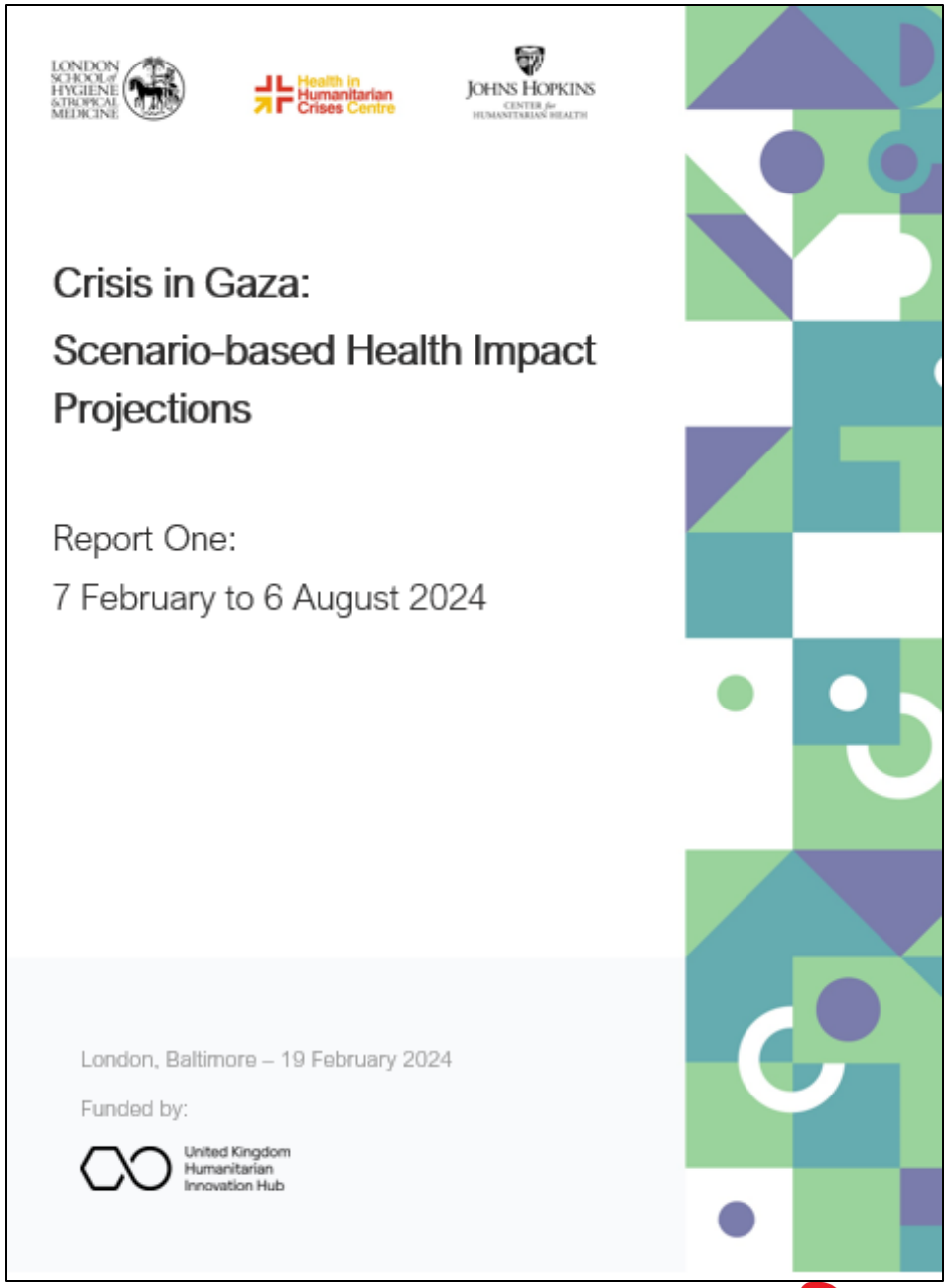
Three scenarios:

1. Ceasefire
2. Status quo (15 October to 15 January)
3. Escalation

Elements of the scenarios include:

- Intensity/typology of military activity
- Population movement
- Occurrence/ duration of any pauses/ceasefires
- Humanitarian space and operational adaptation

Ethical approval for project received from LSHTM & JHU



Methods: Cause-specific mortality modules

Modules	Diseases included in each module
Traumatic injuries	Immediate deaths, deaths due to wounds, unreported deaths, and mild, moderate and severe injuries
Infections: endemic	Airborne droplet transmission: Hib bacterial meningitis and pneumonia, Pneumococcal invasive disease and pneumonia, Respiratory syncytial virus disease, COVID-19, Influenza and para-influenza disease. Faecal-oral transmission: Rotavirus gastroenteritis, Other viral gastroenteritis, Bacterial gastroenteritis
Infections: epidemic	Diphtheria, Measles, Pertussis, Meningococcal meningitis, Polio, Hepatitis A, Hepatitis E, Cholera, Typhoid fever, Bacterial dysentery
Maternal, neonatal, stillbirths	Direct and indirect maternal deaths: antepartum & postpartum haemorrhage, hypertensive diseases of pregnancy, sepsis, obstructed labour, Neonatal: Birth asphyxia, prematurity, sepsis/pneumonia, congenital anomalies, diarrhoea, all other causes of death . Stillbirth
Non-communicable diseases (NCDs)	Ischemic heart disease, cancer haemorrhagic and ischaemic stroke, chronic kidney disease, diabetes type 1

- Malnutrition analysed as an underlying cause
- Important omissions: DM2, COPD, some CVD conditions, accidents, suicide…

Data sources/ Risk factors and health system disruptions

Data sources

1. Pre-war data (e.g. MoH, UNRWA, WHO)
2. Data since start of crisis (e.g. OCHA, WFP, UNRWA, WHO)
3. Publicly available data & and peer-reviewed articles / reports from similar contexts
4. Expert consultations (injuries) and structured expert elicitation (infections) to estimate key quantities for each scenario

Snapshot of some parameters and assumptions:

Parameter	Relevant to			Value by scenario		
	Infections	MNH	NCD	Ceasefire	Status quo	Escalation
Epidemiological risk factors						
WASH						
Mean liters of water/ person/ day	X	X		20-40	6-10	3-6
Persons per toilet	X	X		130-350	450-800	580-1000
Shelter						
%living in shelters or camps	X			50-60%	70-80%	90-95%
Size of shelters/ camps	X			5000 per shelter	7500 per shelter	8500 per shelter
Health system disruptions						
% w/ access to functional outpatient services (e.g. Ab. or ORS)	X	X		50-70%	20-40%	5-10%
% w/ access to functional inpatient services	X		X	20-70%	10-15%	5-10%

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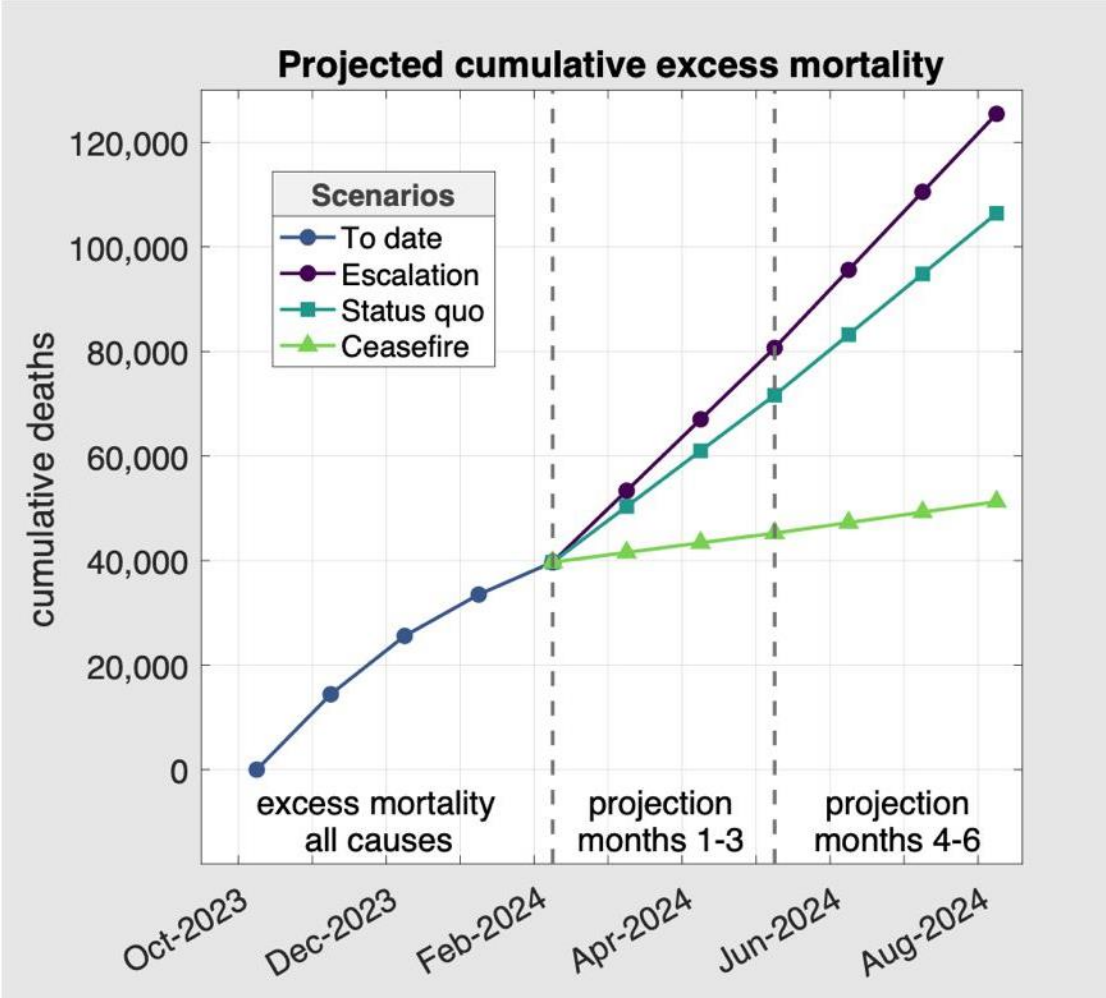
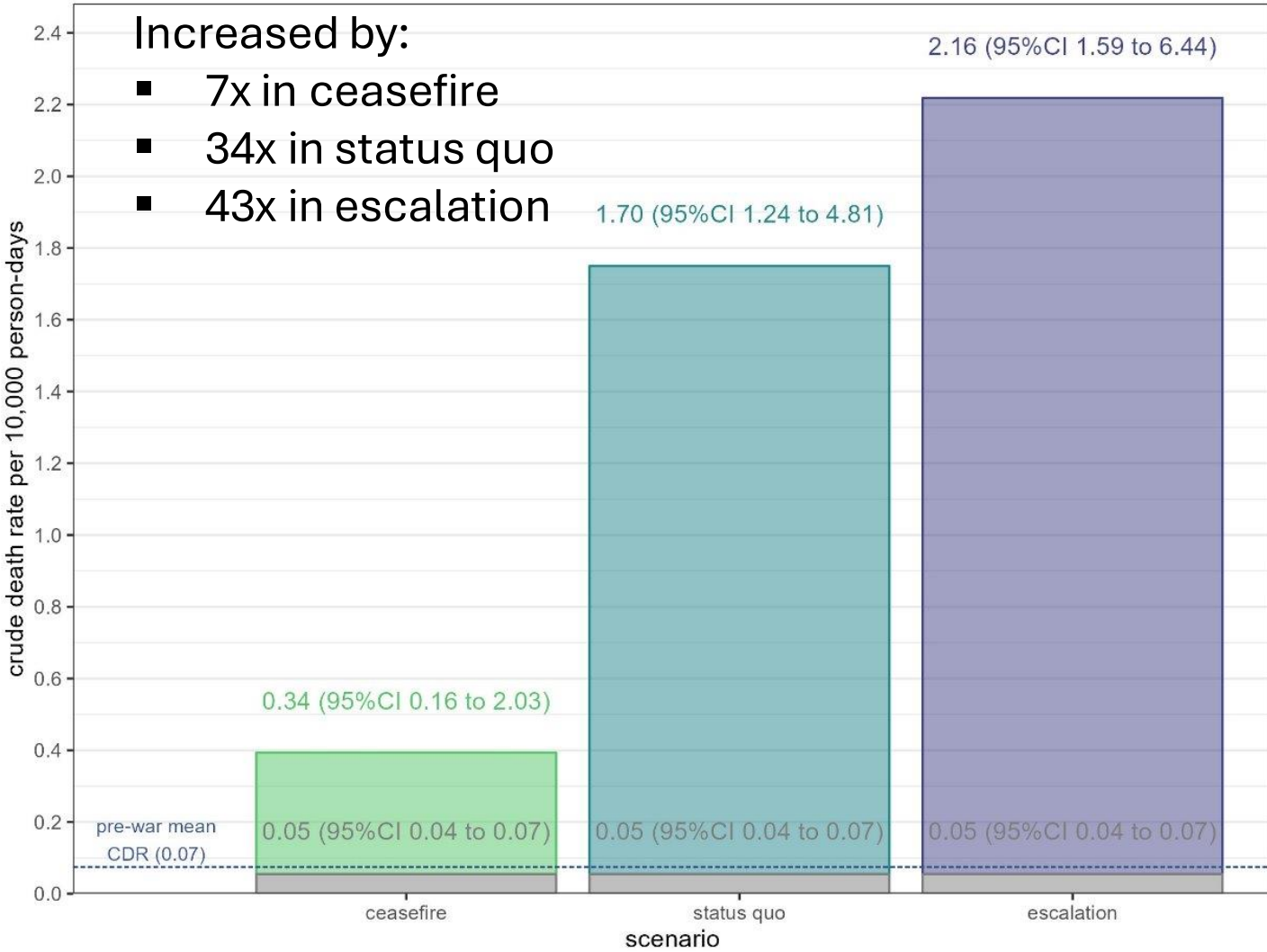
Overall projected excess deaths: 7 Feb- 6 Aug 2024





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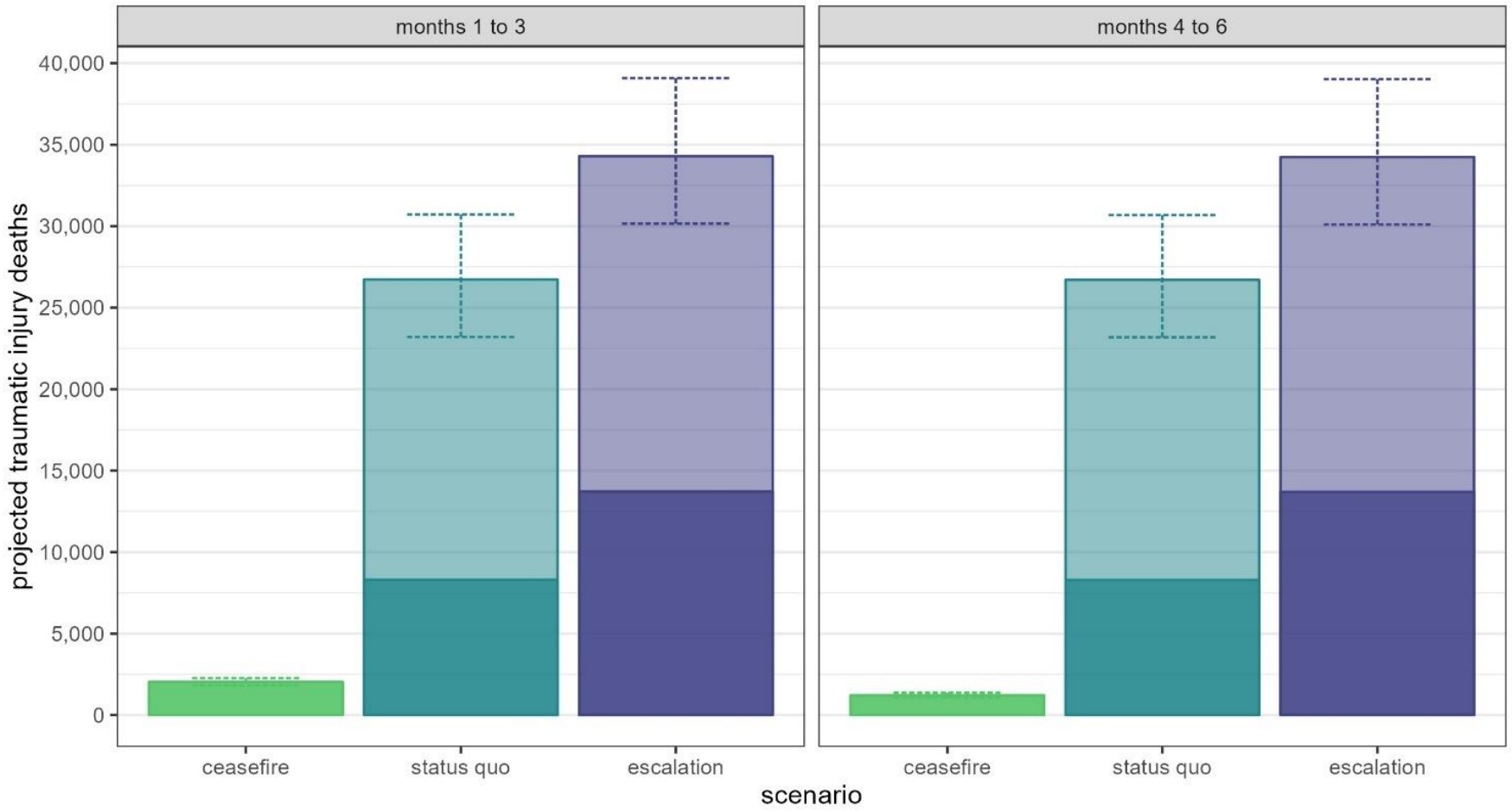
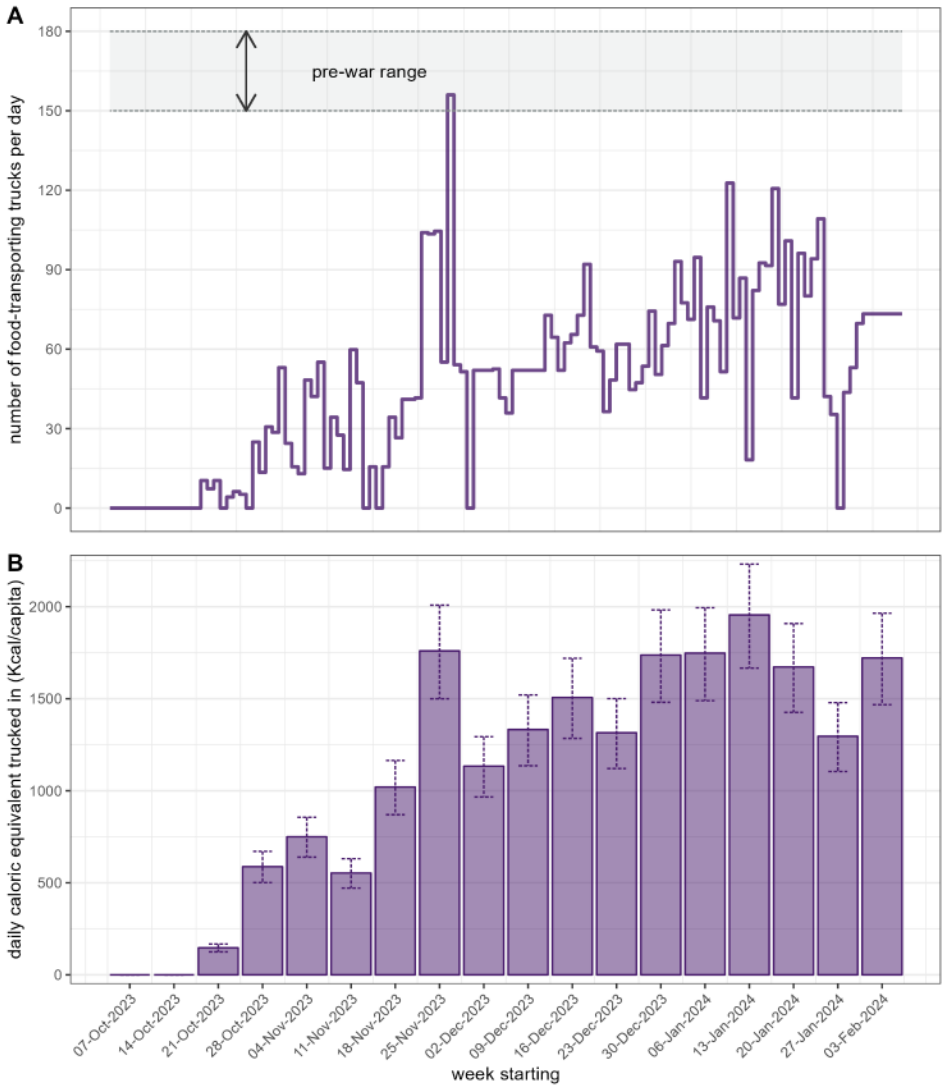
Traumatic injuries: deaths by scenario, overall and due to wounds

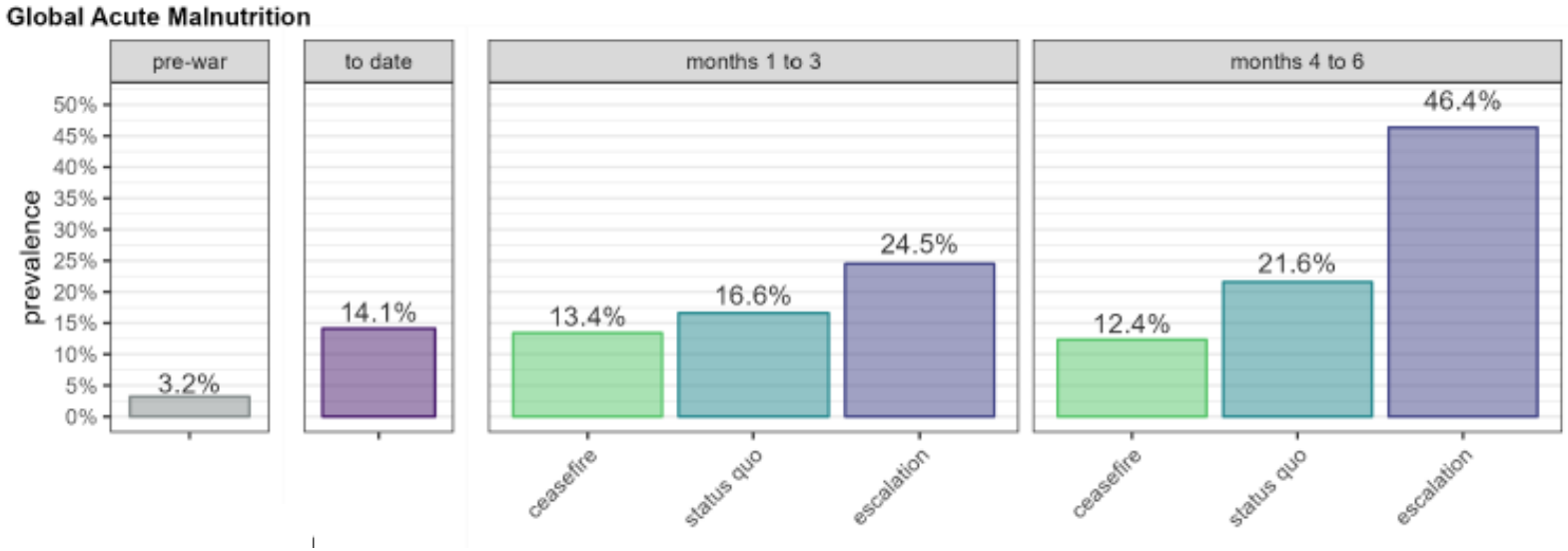
- Estimated the reporting fraction to adjust for MoH under-reporting
- Estimated the proportion of injuries that lead to immediate death (1 – deaths due to wounds)
- Ceasefire scenario: deaths due to wounds sustained during the war, unexploded ordnance



Lighter : immediate traumatic injury deaths
Darker: deaths due to wounds among people who initially survived

Malnutrition: Projected acute malnutrition prevalence in children





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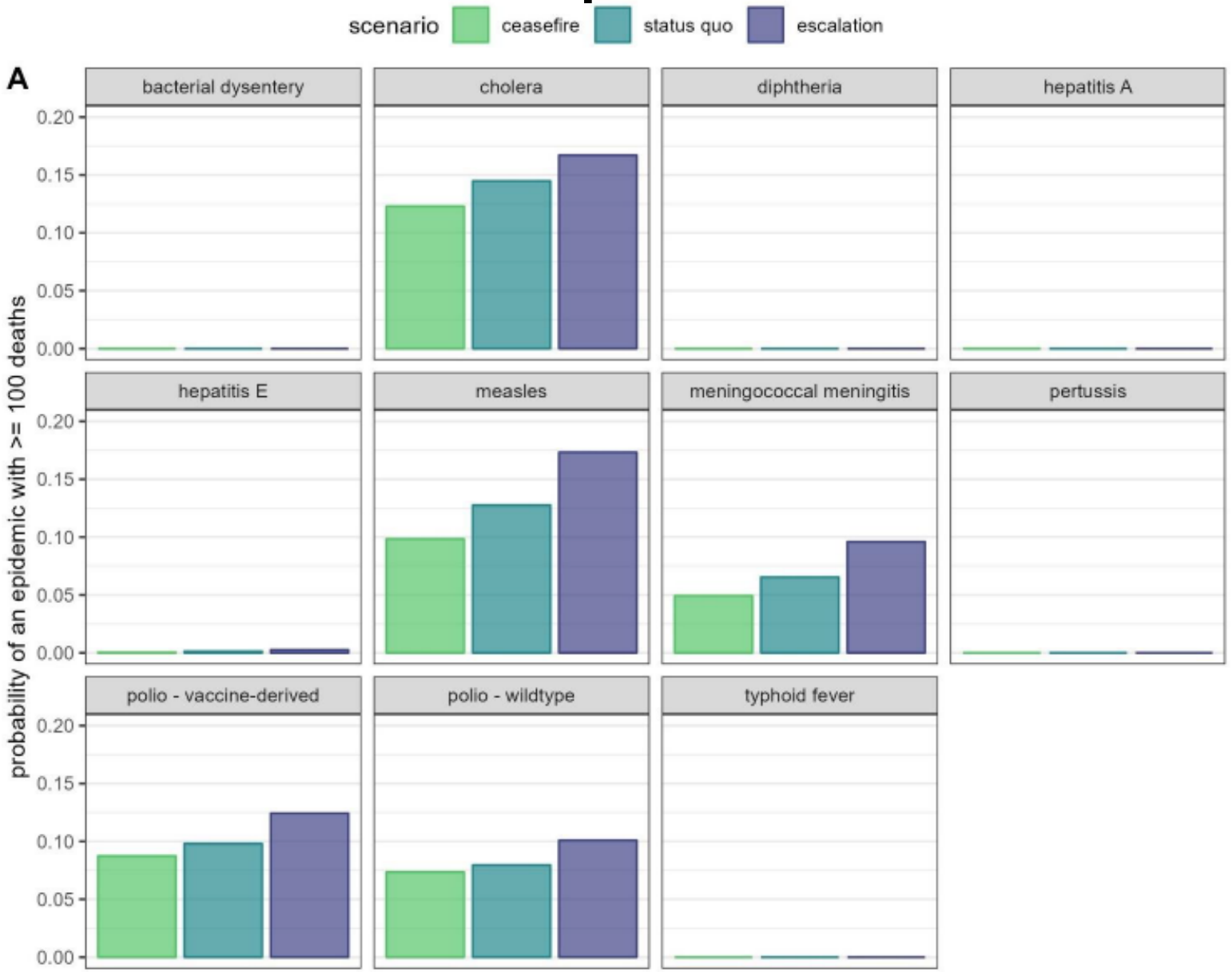
Infectious diseases: Endemic infections

- Dynamic cohort model to track immunity to infection and disease (vaccine coverage , effectiveness, natural prewar exposure to infection)
- Structured Expert Elicitation to quantify probability of epidemic, transmissibility (basic reproduction number, R_0) , case-fatality ratio (CFR)
- Projected counterfactual, no crisis estimate of 191 (95% CI 156-237) deaths
- Multiplied baseline by RR of transmissibility, RR of case-fatality

Disease	Period	Scenario		
		ceasefire	status quo	escalation
bacterial gastroenteritis	months 1 to 3	20 (2 to 61)	33 (3 to 84)	36 (3 to 86)
	months 4 to 6	18 (2 to 59)	31 (3 to 81)	39 (3 to 92)
	total	38 (4 to 120)	64 (5 to 165)	75 (7 to 179)
COVID-19	months 1 to 3	405 (-24 to 1,531)	553 (-13 to 2,031)	680 (-5 to 2,549)
	months 4 to 6	177 (-10 to 688)	244 (-5 to 863)	349 (2 to 1,318)
	total	582 (-34 to 2,219)	797 (-17 to 2,894)	1,029 (-3 to 3,866)
haemophilus influenzae type b disease	months 1 to 3	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	months 4 to 6	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
	total	0 (0 to 0)	0 (0 to 0)	0 (0 to 0)
influenza, para-influenza	months 1 to 3	236 (-14 to 891)	323 (-7 to 1,186)	398 (-3 to 1,491)
	months 4 to 6	17 (-1 to 65)	23 (0 to 82)	33 (0 to 125)
	total	252 (-15 to 956)	346 (-8 to 1,268)	431 (-3 to 1,616)
viral gastroenteritis (other than rotavirus)	months 1 to 3	20 (2 to 61)	33 (3 to 84)	36 (3 to 86)
	months 4 to 6	18 (2 to 59)	31 (3 to 81)	39 (3 to 92)
	total	38 (4 to 120)	64 (5 to 165)	75 (7 to 179)
pneumococcal disease	months 1 to 3	243 (-14 to 920)	333 (-8 to 1,222)	410 (-3 to 1,535)
	months 4 to 6	242 (-14 to 944)	335 (-6 to 1,186)	479 (2 to 1,812)
	total	486 (-28 to 1,864)	668 (-14 to 2,408)	889 (0 to 3,347)
rotavirus	months 1 to 3	10 (1 to 31)	16 (1 to 42)	18 (2 to 43)
	months 4 to 6	9 (1 to 29)	16 (1 to 41)	19 (2 to 46)
	total	19 (2 to 60)	32 (3 to 82)	37 (3 to 89)
RSV	months 1 to 3	99 (-6 to 373)	135 (-3 to 497)	167 (-1 to 625)
	months 4 to 6	9 (-1 to 34)	12 (0 to 43)	18 (0 to 66)
	total	107 (-6 to 407)	148 (-3 to 540)	185 (-1 to 692)

Infectious diseases: Epidemic infections



- Overall, we project 5,026 (95%CI 0 to 58,741) excess deaths in the ceasefire scenario, 8,463 (0- 100,323) in status quo scenario and 11,457 (0 to 128,917) deaths in escalation scenario.
- High uncertainty
- Cholera: up to 120,000 deaths in escalation scenario (if introduced)
- Other threats:
  - Measles
  - Polio
  - Meningococcal meningitis

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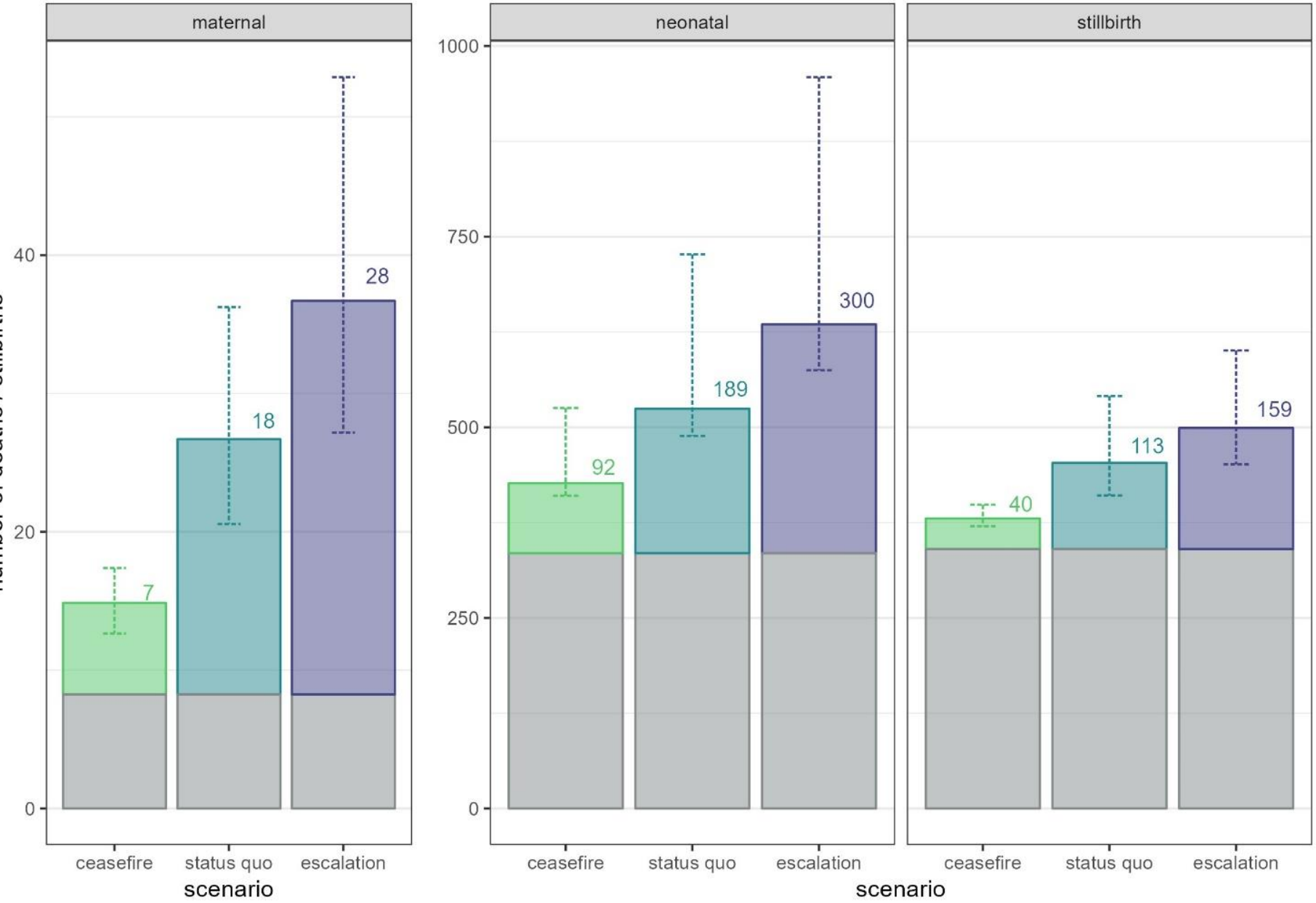
Maternal and neonatal: Reversion of MMR and NMR seen 10-20 years ago



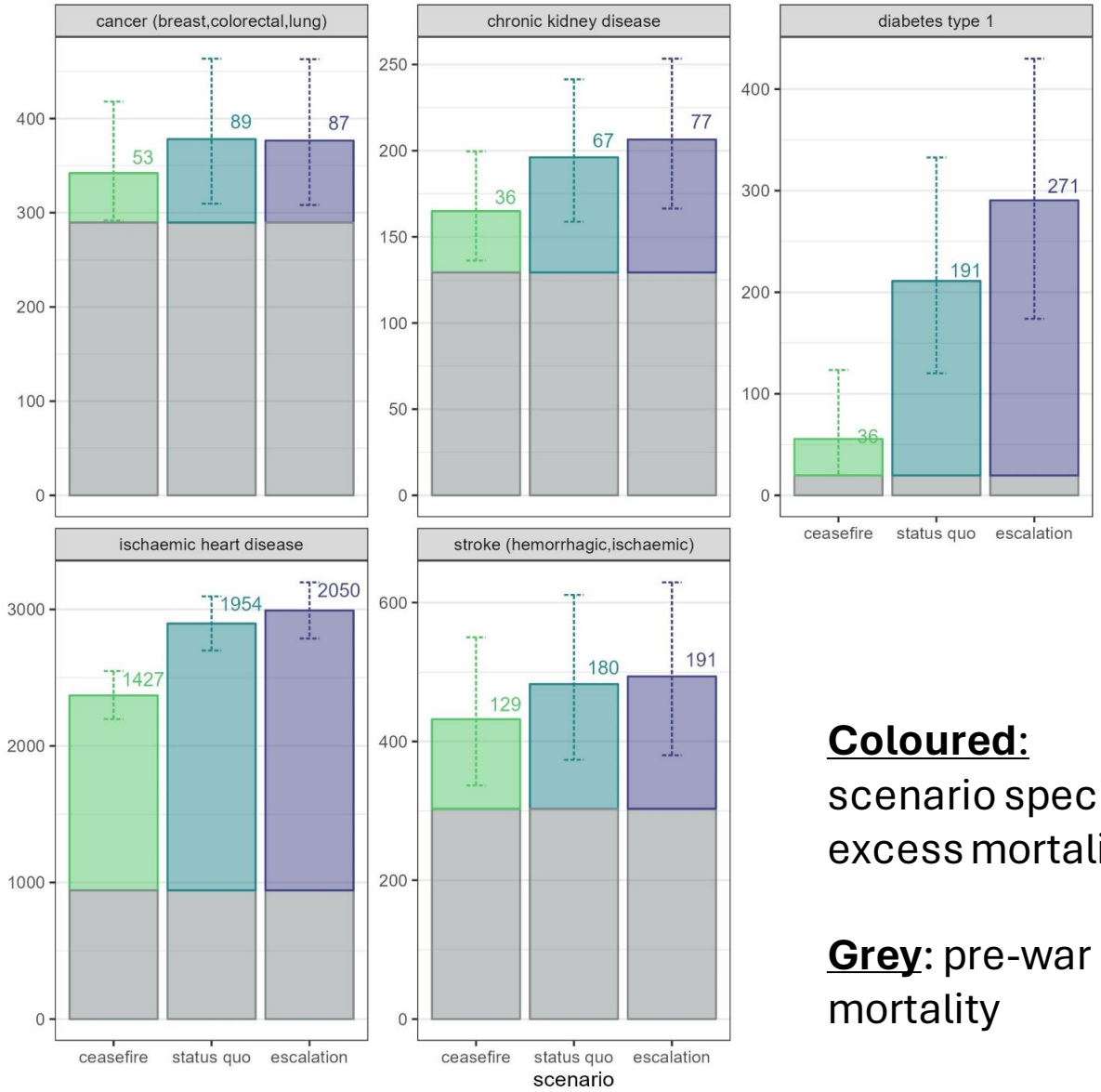
Changed the service coverage and quality depending on the scenario

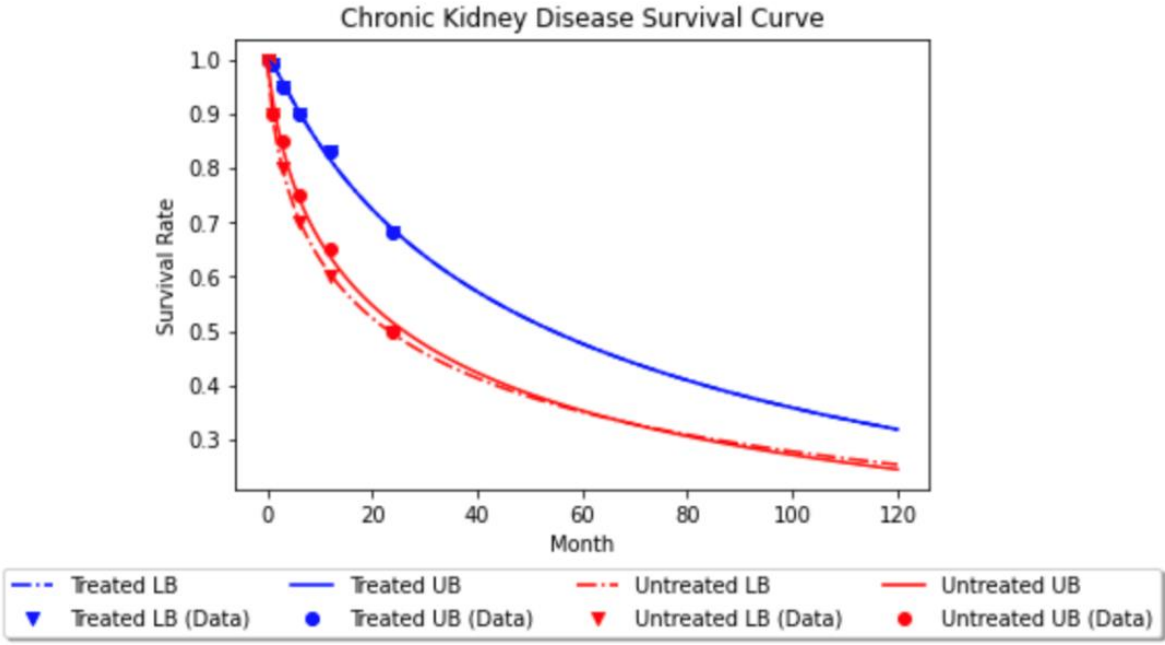
- Antenatal care
- Health facility childbirth care
- Breastfeeding
- WASH
- Food insecurity

Coloured: scenario specific excess mortality

Grey: pre-war mortality

Non-communicable disease: Interrupted access to healthcare





Coloured: scenario specific excess mortality

Grey: pre-war mortality

Multiplied baseline mortality data by RRs representing changes in access to treatment, with relative survival quantified through literature review

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SCIENTIFIC DAYS

Overall projected excess

Cause	Total projection period (7 Feb to 6 Aug 2024)		
	ceasefire	status quo	escalation
Traumatic injuries	**3,250** (2,900 to 3,640)	**53,450** (46,090 to 61,830)	**68,560** (59,950 to 78,730)
Infectious diseases - *endemic*	**1,520** (-70 to 5,750)	**2,120** (-30 to 7,520)	**2,720** (10 to 9,970)
Infectious diseases - *epidemic*	**5,030** (0 to 68,630)	**8,470** (0 to 120,350)	**11,460** (0 to 167,030)
Maternal and neonatal health	**100** (80 to 200)	**210** (170 to 420)	**330** (260 to 670)
Non-communicable diseases	**1,680** (1,300 to 2,160)	**2,480** (1,980 to 3,060)	**2,680** (2,130 to 3,290)
Total <u>excluding</u> epidemics	**6,550** (4,200 to 11,740)	**58,260** (48,210 to 72,830)	**74,290** (62,350 to 92,650)
Total <u>including</u> epidemics	**11,580** (4,200 to 80,370)	**66,720** (48,210 to 193,180)	**85,750** (62,350 to 259,680)

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SCIENTIFIC DAYS

Acknowledgement

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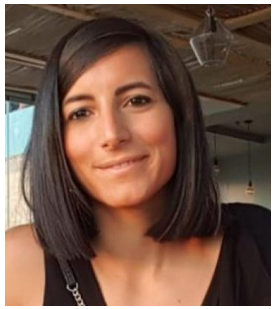

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SCIENTIFIC DAYS