DISPATCH EFFICIENCY IN MEDEVAC OPERATIONS

Analysis and Simulation

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AGENDA

1. **Introduce MEDEVAC, Casualty Triage, and Dispatch Policies**
2. Simulation Metrics
3. Execution of Simulation
4. Simulation Results and Conclusions
5. References and Appendix
6. Questions

MEDICAL EVACUATION (MEDEVAC)

EVACUATION TRIAGE (US STANDARDS)

- "CAT A"/URGENT: Alpha category includes urgent casualties that need to be treated within one hour. this is also known as the golden hour.

- "CAT B"/PRIORITY: Bravo category includes priority casualties that need to be treated within four hours.

- "CAT C"/ROUTINE: Charlie category includes routine casualties that need to be treated within twenty-four hours.

DISPATCH POLICIES

9-LINE calls come into a dispatcher who makes an allocation judgement with regards to:

1.) Which MEDEVAC asset will preform the evacuation
2.) Which medical facility the patient will be transported to

Transporting casualties to a medical treatment facility in a timely manner prevents the deteriorating health and potential death of casualties

THE MOST EFFECTIVE MEDEVAC DISPATCH POLICIES MAY SEEM COUNTER-INTUITIVE.

WHAT IS BEST FOR ONE PATIENT IS NOT BEST FOR ALL PATIENTS IN THE AREA OF OPERATION ALL THE TIME.

DISPATCH POLICIES

1.) Myopic Policy: The closest MEDEVAC asset will be assigned to the casualty event, provided it is in the same, or a bordering, province.

2.) Intra-Zone Policy: MEDEVAC assets may only evacuate in their designated province.

3.) Optimal Policy: MEDEVAC assets will follow a myopic policy for all urgent casualty events. Priority and routine casualty events will have less-utilized assets from neighboring zones dispatched.

METRIC OF INTEREST: TOTAL UTILITY

60 minutes

4 hours

24 hours

Assuming the category RTT is met:

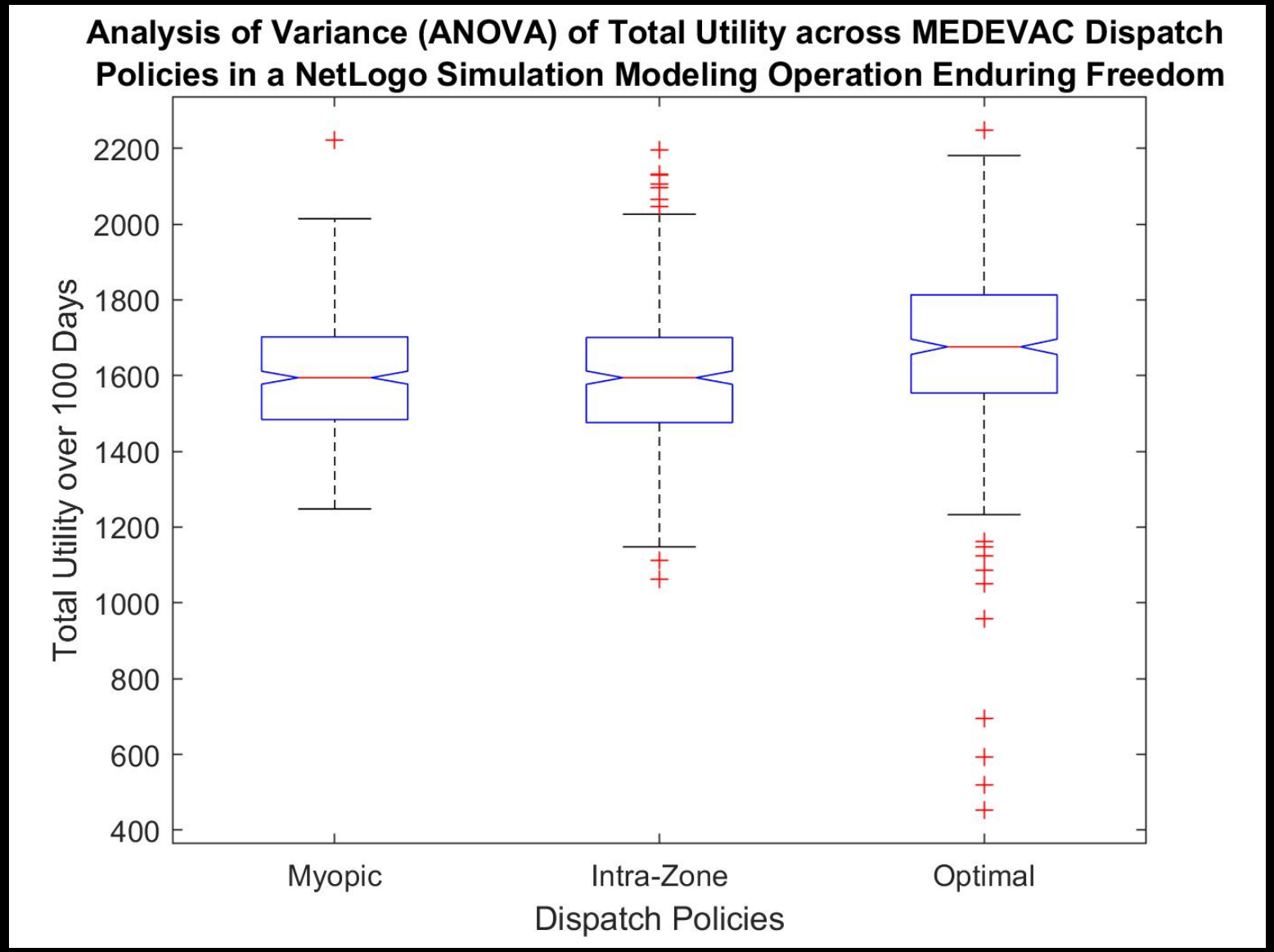
- each Urgent casualty is equivalent to 10 utility
- each Priority casualty is equivalent to 1 utility
- each Routine casualty is equivalent to 0 utility*

Utility will be totaled for myopic, intra-zone, and optimal dispatch policies

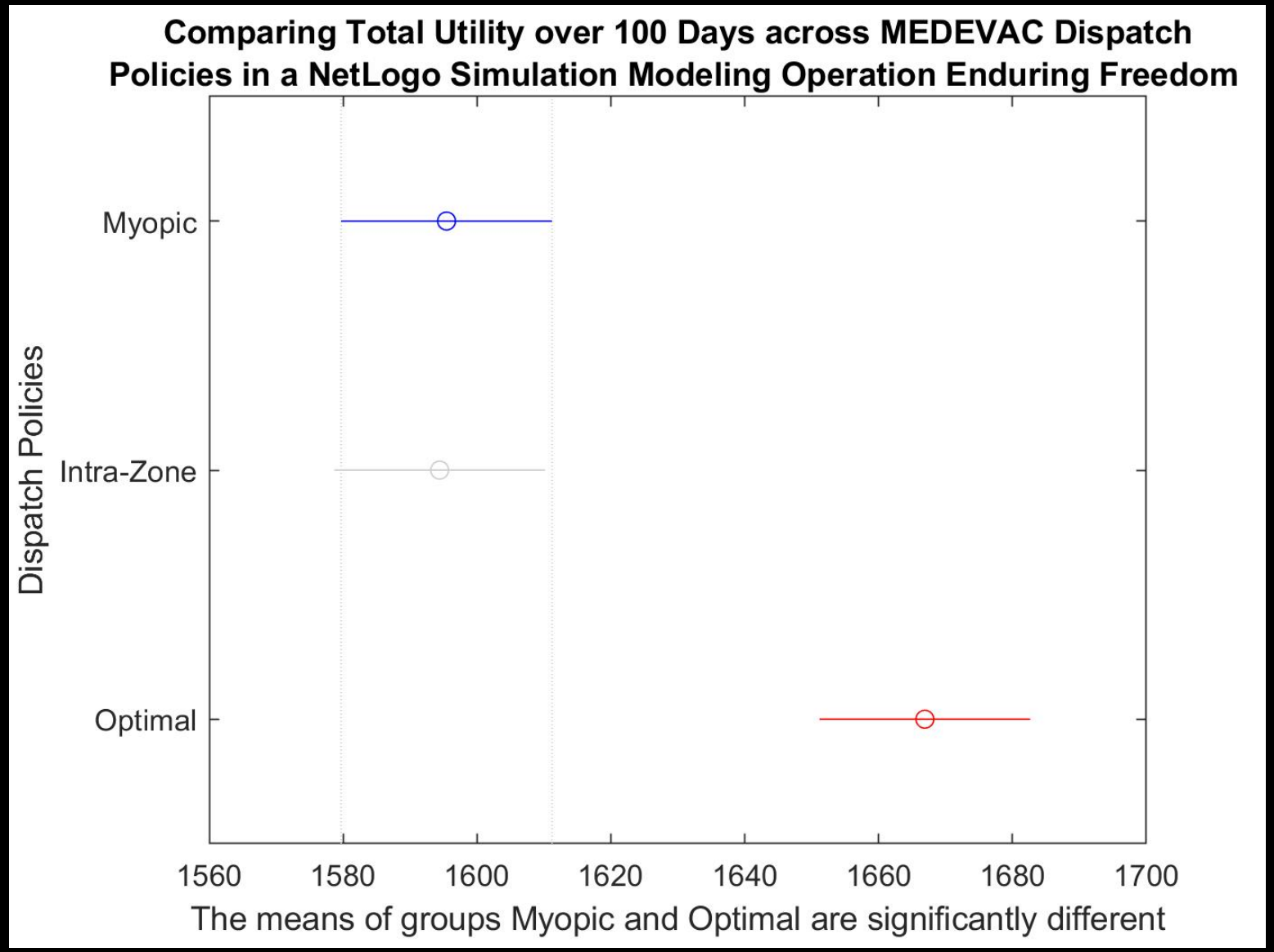
PROVINCES OF SOUTHERN AFGHANISTAN

NETLOGO SIMULATION PENDING

ANALYSIS OF VARIANCE (ANOVA) RESULTS



MULTIPLE COMPARISONS RESULTS



CONCLUSIONS

- The more effective optimal dispatch policy requires Brigade Combat Teams (BCTs) responsible for different provinces to co-utilize MEDEVAC assets.

- Simple rules of thumb, such as those underlying intra-zone and myopic policies, are not as effective as dispatching strategies tailored to geographic and casualty propensity data.

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MODEL SIMPLIFYING ASSUMPTIONS

Seeking to emulate Operation Enduring Freedom in Southern Afghanistan

- No queue for evacuation. CASEVAC employed if MEDEVAC is unavailable
- All MEDEVAC assets may be configured to meet mission needs
- A casualty event may have between one and four casualties, and a single MEDEVAC asset may evacuate up to four casualties
- Travel times computed linearly
- All medical treatment facilities (MTF) have the same capabilities
- The four provinces are arranged laterally

INPUT PARAMETERS I

- Number of casualties:
  57.4% of events consisted of one casualty, 36.0% of events consisted of two casualties, 5.0% consisted of three casualties, and 1.6% consisted of four casualties.

- Event (NOT casualty) priority-classification:
  15.87% of events are urgent, 15.74% of events are priority, and 68.39% of events are routine

- Location of the event:
  BDE AO is split into four provinces: Nimroz, Helmand, Kandahar, Zabul

- Number of events:
  average of 134 missions per month

- Location of the MEDEVAC asset:
  one in each province, randomly placed

INPUT PARAMETERS II

- Location of the MTF:
  one in Helmand and one in Kandahar, randomly placed

- Armed escort likelihood:
  31% of MEDEVAC missions require an armed escort

- MEDEVAC asset characteristics:
  average flight speed of 135 knots

- Times:
  Average dispatch time *D* is fifteen minutes
  Average armed escort delay *A* is ten minutes
  Average casualty load time *L* is ten minutes
  Average casualty unload time *U* is five minutes

- Casualty incidence rate proportions by province:
  Nimroz (0.4%), Helmand (58.5%), Kandahar (33.8%), and Zabul (7.3%)

SIX POSSIBILITIES FOR A MORE ROBUST MODEL

- Employ the model, in reverse, to determine where MEDEVAC assets should be placed for maximum life-saving utility
- Integrate Google Maps Applied Programs Interface (API) to map the model to an actual terrain map of Afghanistan
- Increase propensity for armed escort, thereby representing a higher risk environment
- Increase number of casualty events to stress-test ability of MEDEVAC assets
- Allow a proportion of MEDEVAC assets to continue to another a casualty event after dropping off an evacuee at an MTF, without returning to the original staging location
- Include Role II MTFs capable of handling most casualties

MEDEVAC CHALLENGES

MEDEVAC unit-level challenges are primarily based on procedure, equipment, and the environment.

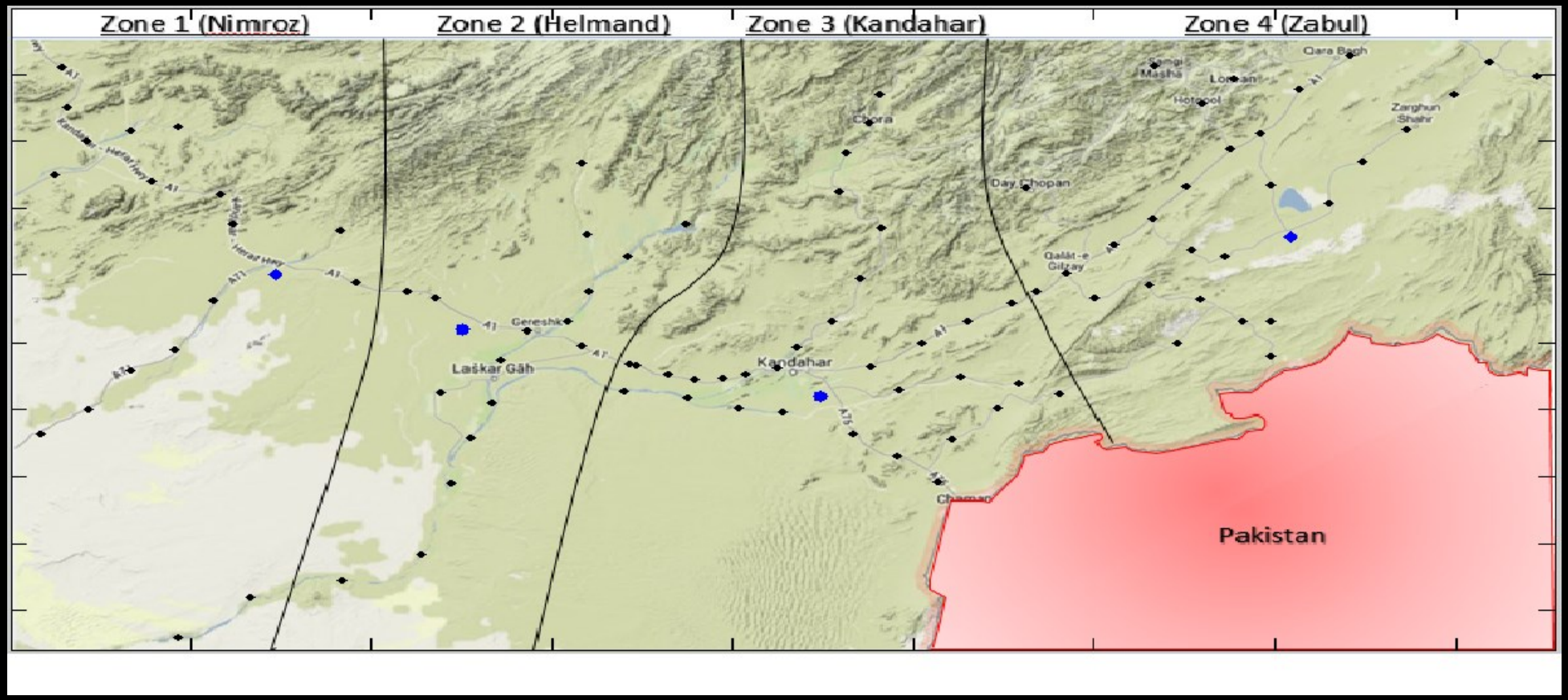
MEDEVAC operational challenges include optimizing location of MEDEVAC assets, **determining dispatch policies**, and repositioning said assets post mission.

MEDEVAC strategic challenges include resource forecasting, enhancing the training pipeline, and ensuring AMEDD control.

PROVINCES OF SOUTHERN AFGHANISTAN

NIMROZ	HELMAND	KANDAHAR	ZABUL

ROBUST OPERATION ENDURING FREEDOM SIMULATION MAP



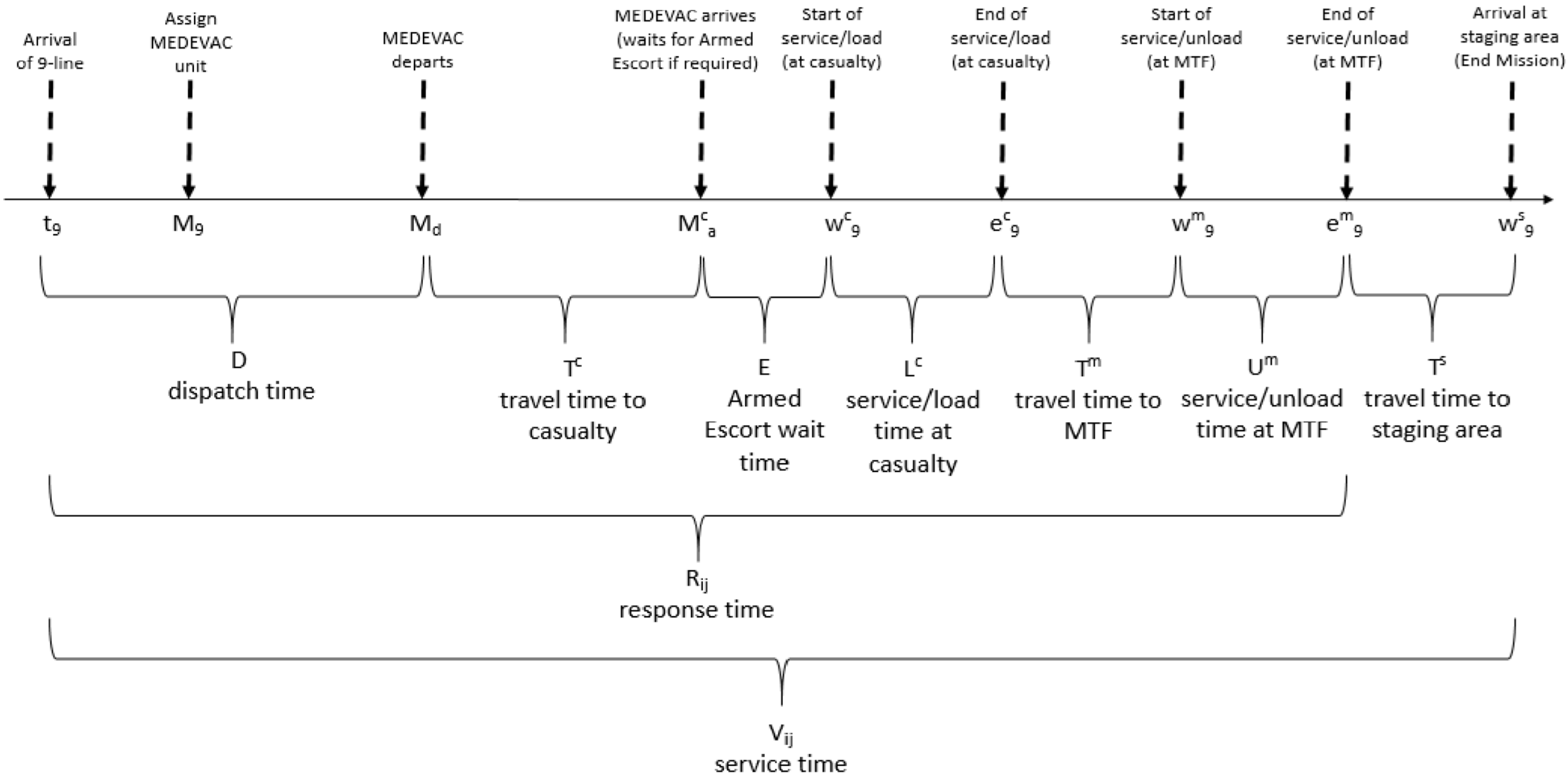


Figure 1. MEDEVAC Mission Timeline

λ = 9-line MEDEVAC request arrival rate, per minute, to the entire system.

ϕ_i = proportion of 9-line MEDEVAC requests from demand zone i such that: $\sum_{i=1}^{n} \phi_i = 1$.

d = total number of demand zones.

m = total number of MEDEVAC units.

p_k = proportion of priority k 9-line MEDEVAC requests such that: $\sum_{k=1}^{3} p_k = 1$.

ψ_{ij}^{k} = utility gained by MEDEVAC j servicing a casualty event with priority k in zone i dependent on the RTT.

μ_{ij} = service rate, per minute, of MEDEVAC j when servicing a casualty event in zone i.