

Simulation-Based Capacity Analysis for Strategic Medical Evacuation to Civilian Healthcare Systems

Falk Stefan Pappert

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ComPat Partner



Kommando Gesundheitsversorgung der Bundeswehr (KdoGesVersBw)
Bundeswehr Medical Support Command



Sanitätsakademie der Bundeswehr (SanAkBw)
Bundeswehr Medical Academy



Unterstützungskommando der Bundeswehr (UstgKdoBw)
Bundeswehr Joint Support Command



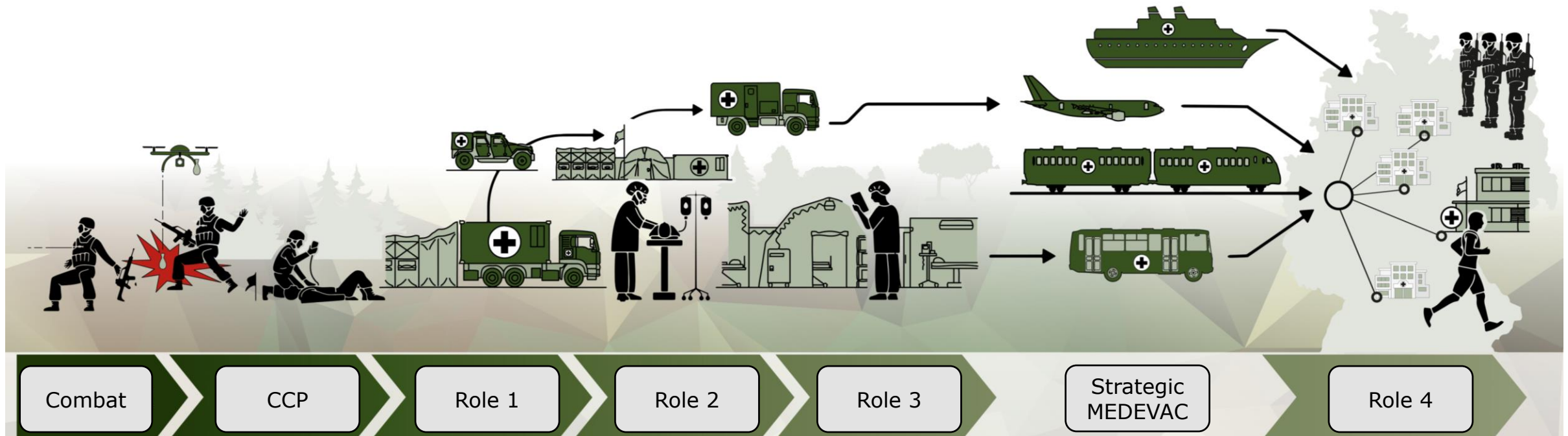
Bundeswehrzentral Krankenhaus (BwZKrhs)
Bundeswehr Central Hospital



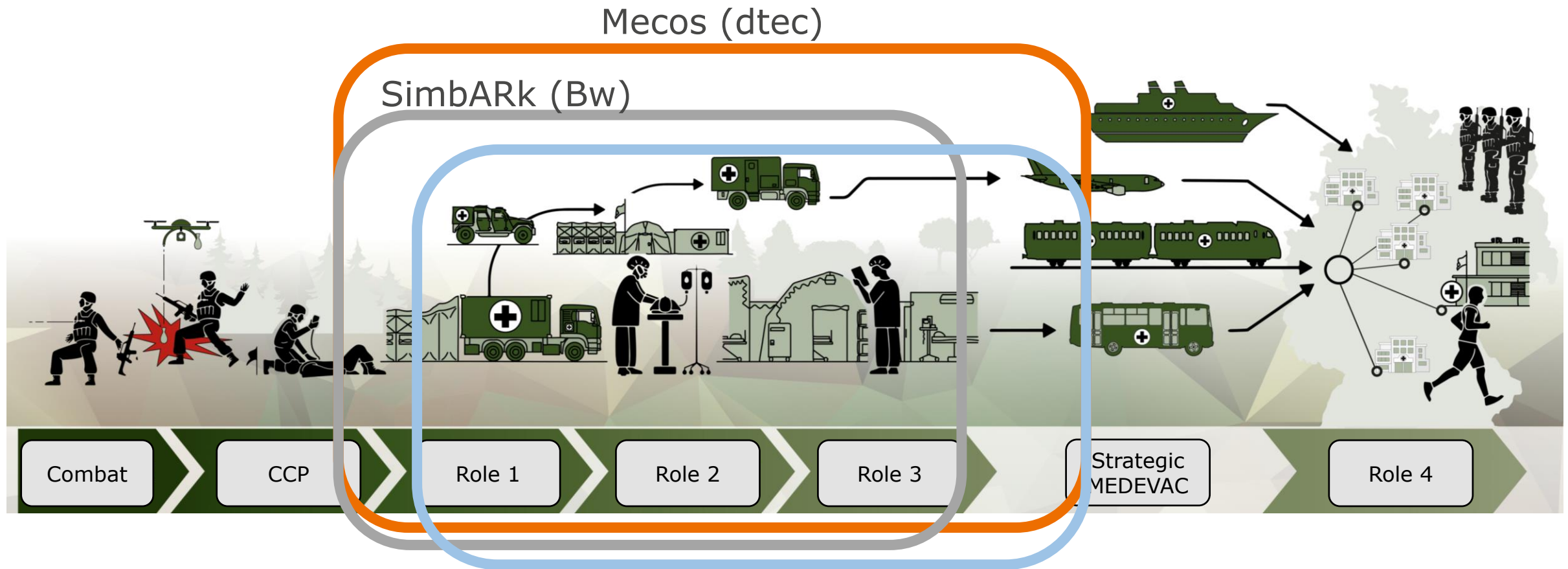
Bundesamt
für Bevölkerungsschutz
und Katastrophenhilfe

The Federal Office of Civil Protection and Disaster Assistance

Overview



Overview



NATO MSG-HFM-239 / Military Medical Support Simulation for Large Scale Combat Operations (LSCO) Planning

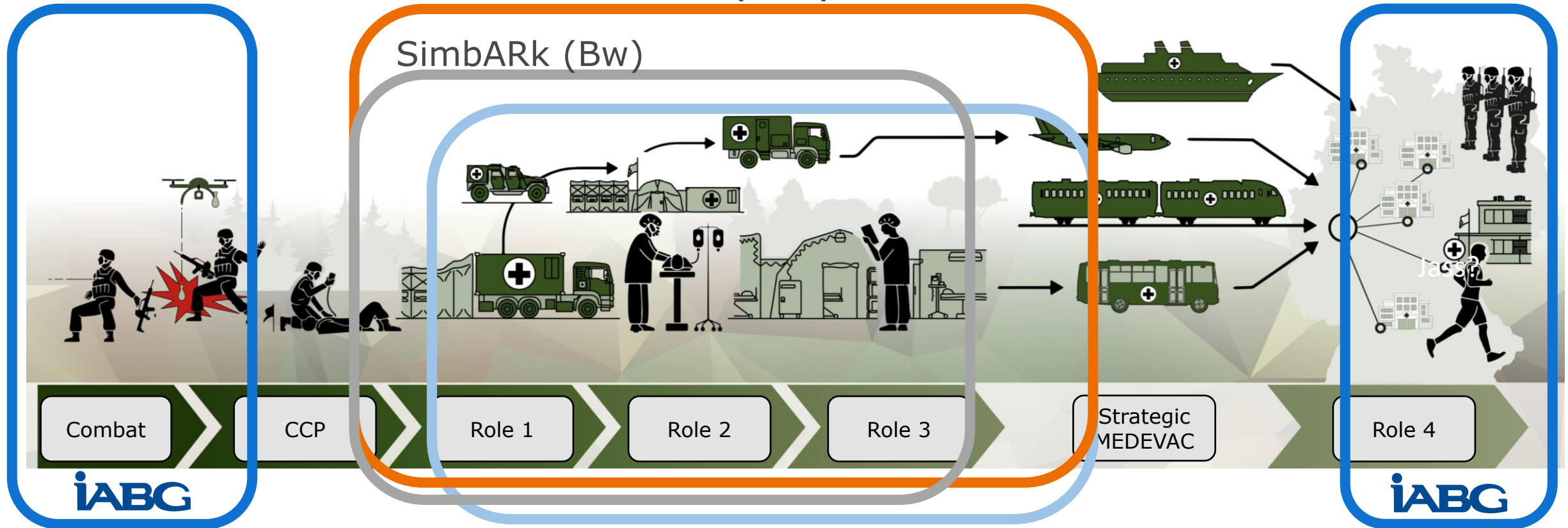
Overview

JASS

Mecos (dtec)

KlinSim

SimbARk (Bw)



NATO MSG-HFM-239 / Military Medical Support Simulation for Large Scale Combat Operations (LSCO) Planning

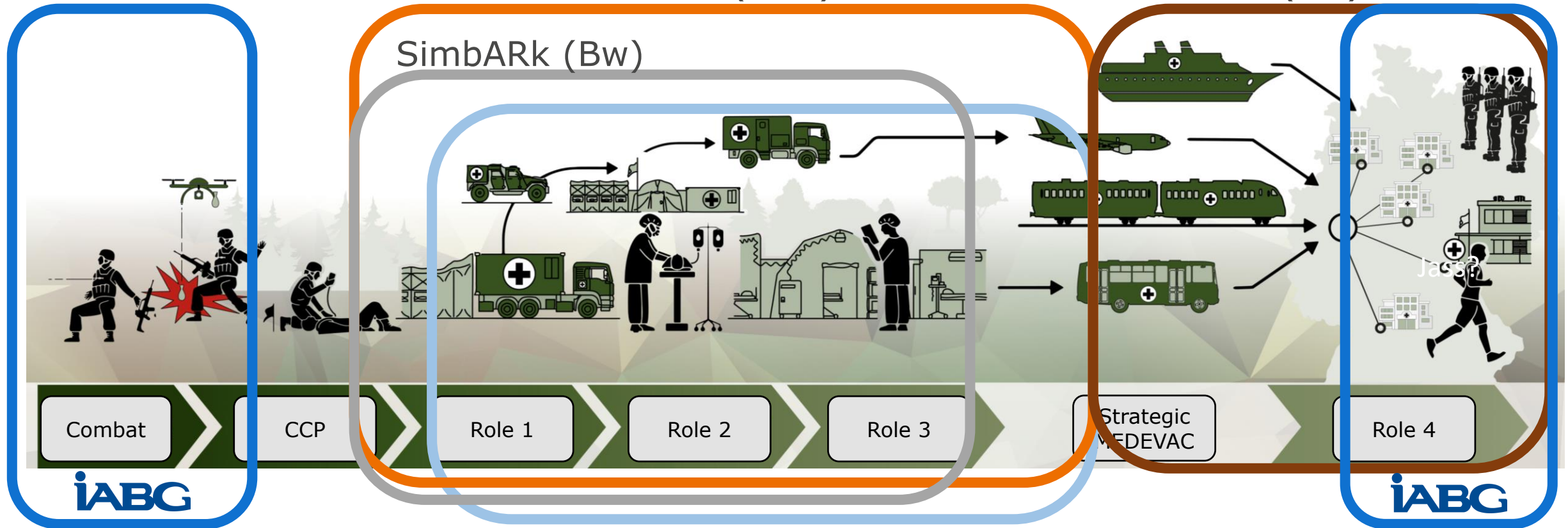
Overview

JASS

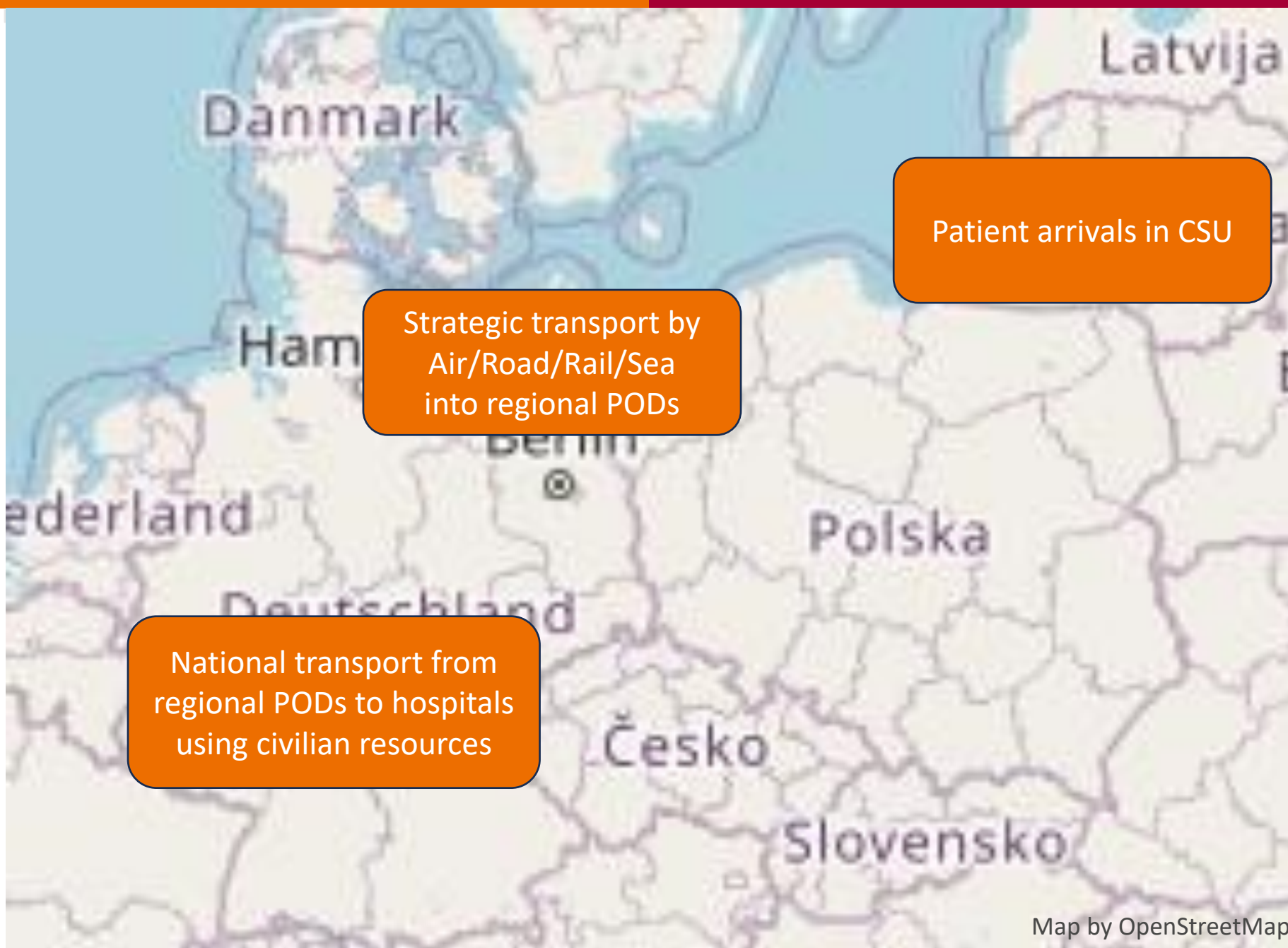
Mecos (dtec)

ComPaT (Bw) KlinSim

SimbARk (Bw)



NATO MSG-HFM-239 / Military Medical Support Simulation for Large Scale Combat Operations (LSCO) Planning

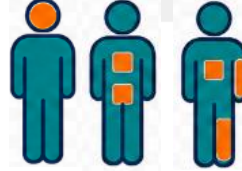


International transport

Patient arrival



Injury pattern



Selection of CSUs and PODs



International Transport

Transport modes



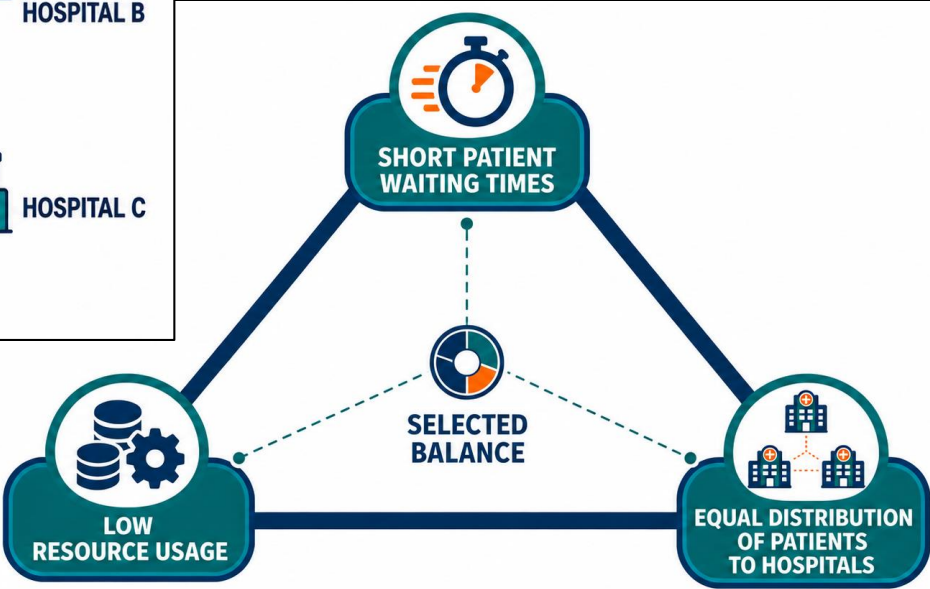
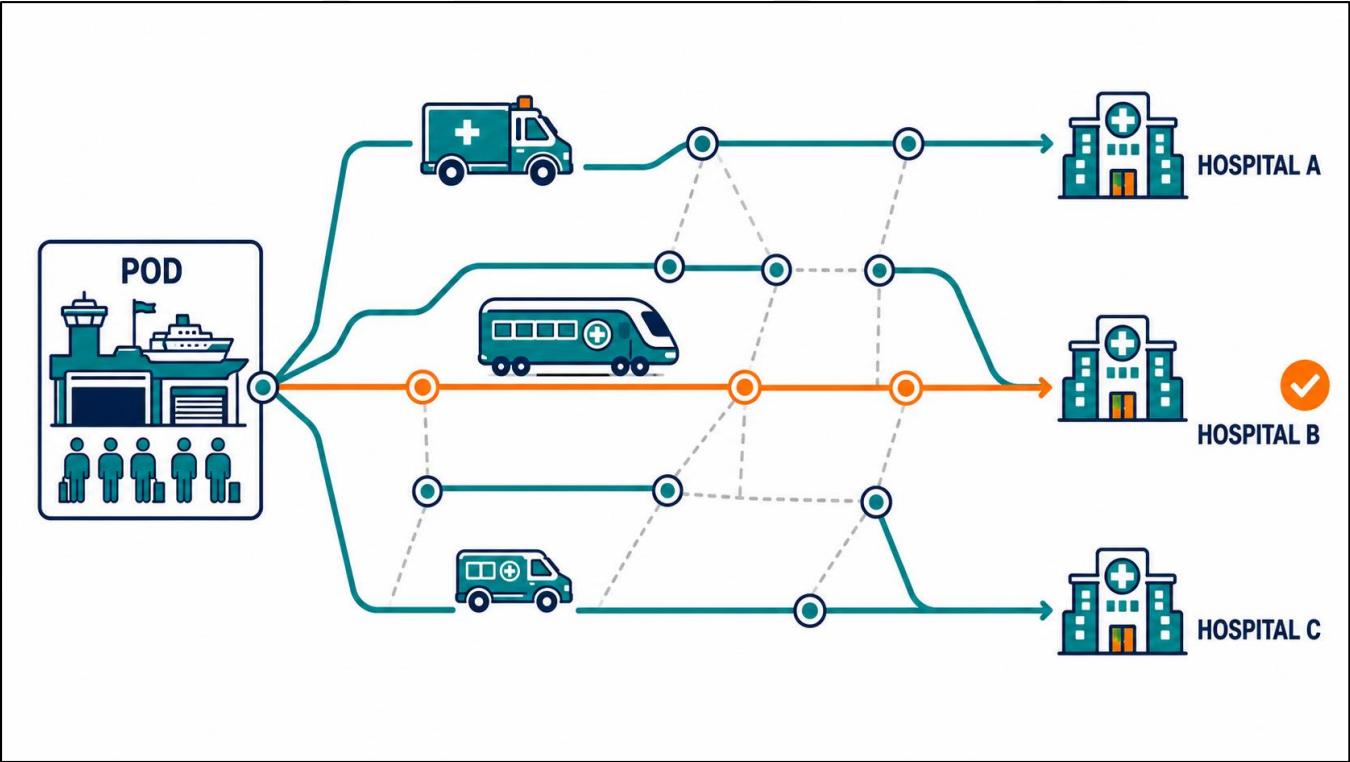
Carrying capacity



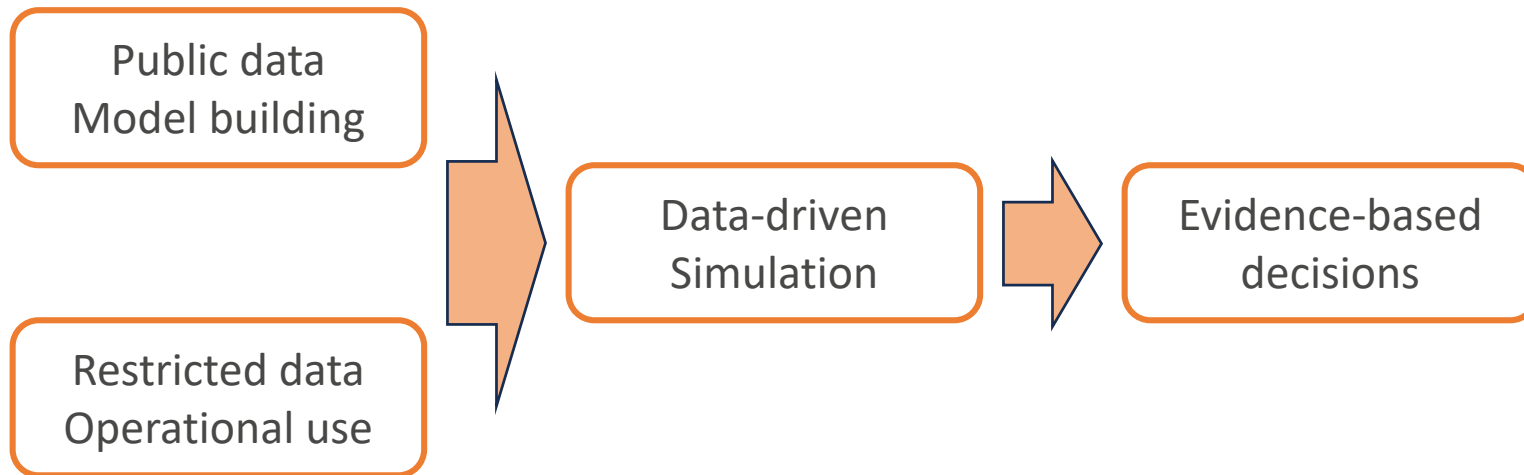
Vehicle & vessel availability



National transport



Data-agnostic simulation architecture



Open model, controlled data

- Public data supports transparent model development and validation.
- Authorized restricted data enables context-specific operational decision support.
- The simulation logic remains separate from the data supplied to it.

A patients path to treatment: Generation

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID	Name	Type	IsInjury	P	D	C	ICU Stretcher	Litter Kit	Seat	HC Time in Days	NC Time in Days	Requires Assistance	Treatment Requirement
2	1	Injury Pattern 1	T1	yes	1	1	3	yes	no	no	5	22	yes	
3	2	Injury Pattern 2	T1	yes	1	1	3	yes	no	no	4	21	yes	
4	3	Injury Pattern 3	T1	yes	1	1	3	yes	no	no	3	20	yes	
5	4	Injury Pattern 4	T1	yes	3	2	3	yes	yes	no	2	21	yes	
6	5	Injury Pattern 5	T1	yes	1	2	3	yes	no	no	5	20	yes	
7	6	Injury Pattern 6	T1	yes	2	3	3	yes	yes	no	4	18	yes	
8	7	Injury Pattern 7	T1	yes	3	3	3	yes	yes	no	2	17	yes	
9	8	Injury Pattern 8	T1	yes	2	3	3	yes	yes	no	1	16	yes	
10	9	Injury Pattern 9	T1	yes	1	4	3	yes	no	no	21	15	yes	Burn
11	10	Injury Pattern 10	T1	yes	2	4	3	yes	no	no	5	21	yes	
12	11	Injury Pattern 11	T1	yes	2	4	3	yes	no	no	6	21	yes	
13	12	Injury Pattern 12	T1	yes	2	4	3	yes	no	no	7	21	yes	
14	13	Injury Pattern 13	T1	yes	2	4	3	yes	no	no	5	21	yes	
15	14	Injury Pattern 14	T1	yes	2	4	3	yes	no	no	8	21	yes	
16	15	Injury Pattern 15	T2	yes	2	4	3	yes	no	yes	0	21	no	
17	16	Injury Pattern 16	T2	yes	2	4	3	yes	yes	yes	0	14	no	Eye
18	17	Injury Pattern 17	T2	yes	2	4	3	yes	yes	yes	0	2	no	

*Dummy data for presentation

A patients path to treatment: Generation

Transport
requirements

Treatment
duration in
hospital

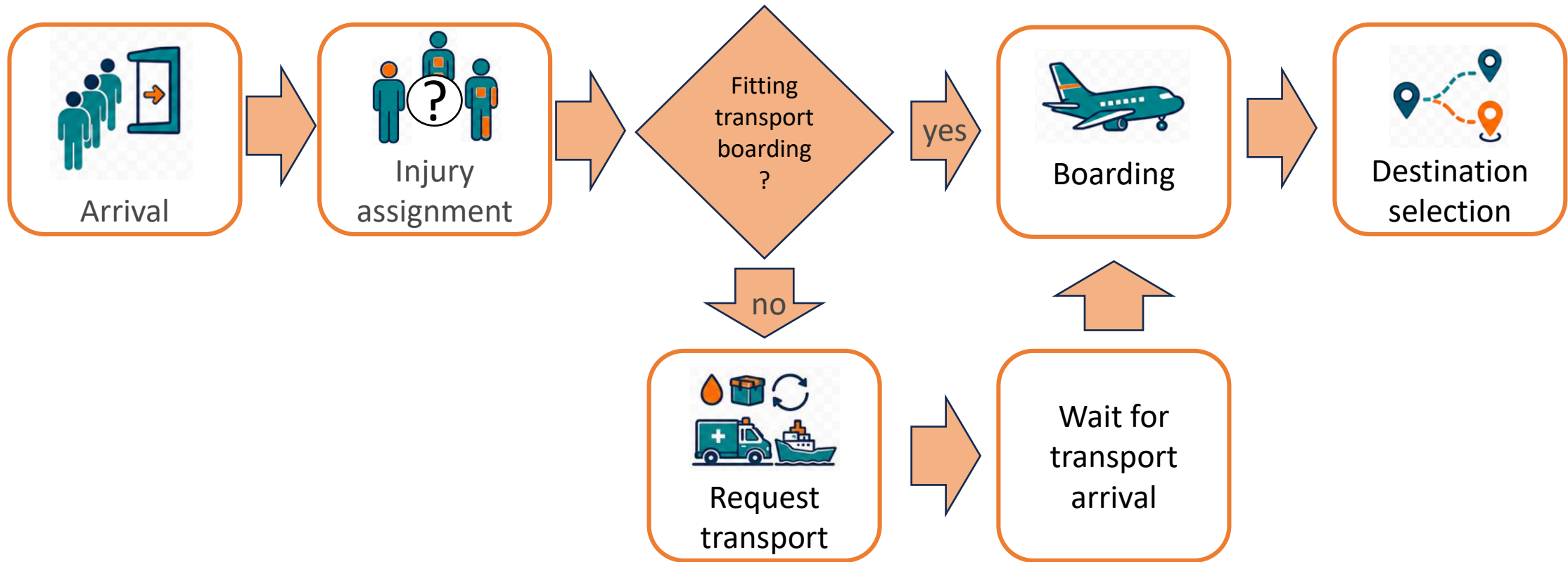
Handling
requirem.

Treatment
requirem.

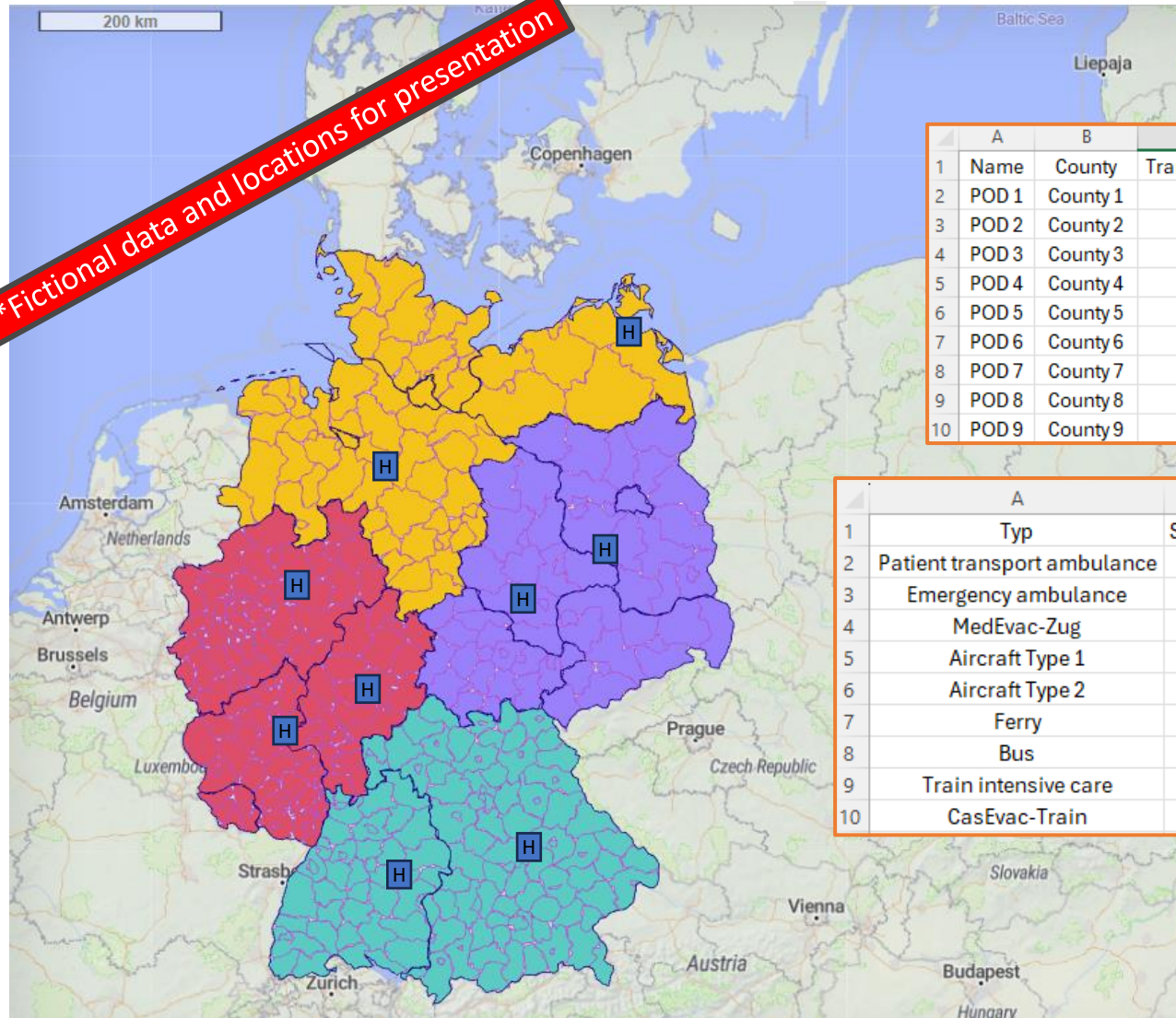
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	ID	Name	Type	IsInjury	P	D	C	ICU Stretcher	Litter Kit	Seat	HC Time in Days	NC Time in Days	Requires Assistance	Treatment Requirement
1	1	Injury Pattern 1	T1	yes	1	1	3	yes	no	no	5	22	yes	
2	2	Injury Pattern 2	T1	yes	1	1	3	yes	no	no	4	21	yes	
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16	16	Injury Pattern 16	T2	yes	2	4	3	yes	yes	yes	0	14	no	Eye
17	17	Injury Pattern 17	T2	yes	2	4	3	yes	yes	yes	0	2	no	

*Dummy data for presentation

A patients path to treatment: CSU



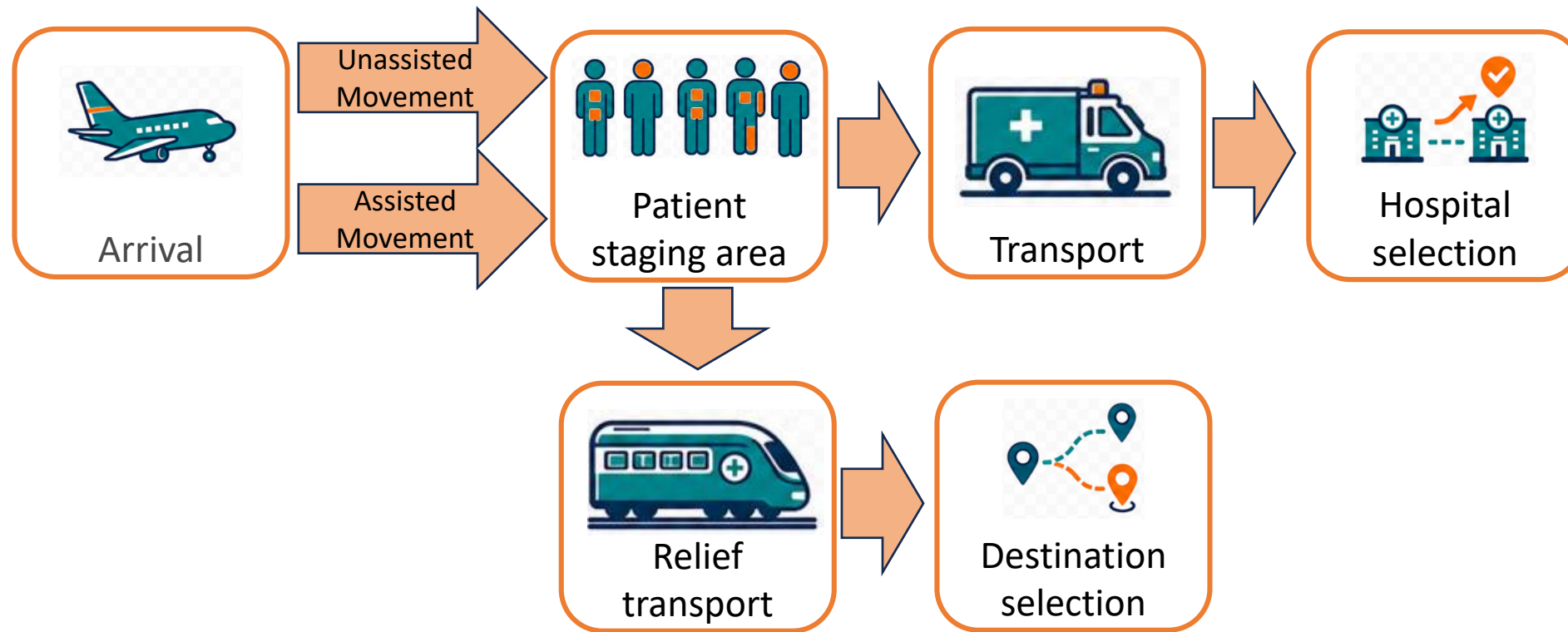
A patients path to treatment: Strategic transport



	A	B	C	D	E	F	G	H
1	Name	County	Transport mode international	Waiting_IC	Waiting_Lying	Carrying teams	Carrying duration	Transport paths
2	POD 1	County 1	Rail	10	50	8	10	8
3	POD 2	County 2	Road	10	50	8	10	8
4	POD 3	County 3	Rail	10	50	8	10	8
5	POD 4	County 4	Air	10	50	8	10	8
6	POD 5	County 5	Air	10	50	8	10	8
7	POD 6	County 6	Rail	10	50	8	10	8
8	POD 7	County 7	Air	10	50	8	10	8
9	POD 8	County 8	Rail	10	50	8	10	8
10	POD 9	County 9	Sea	50	250	8	10	8

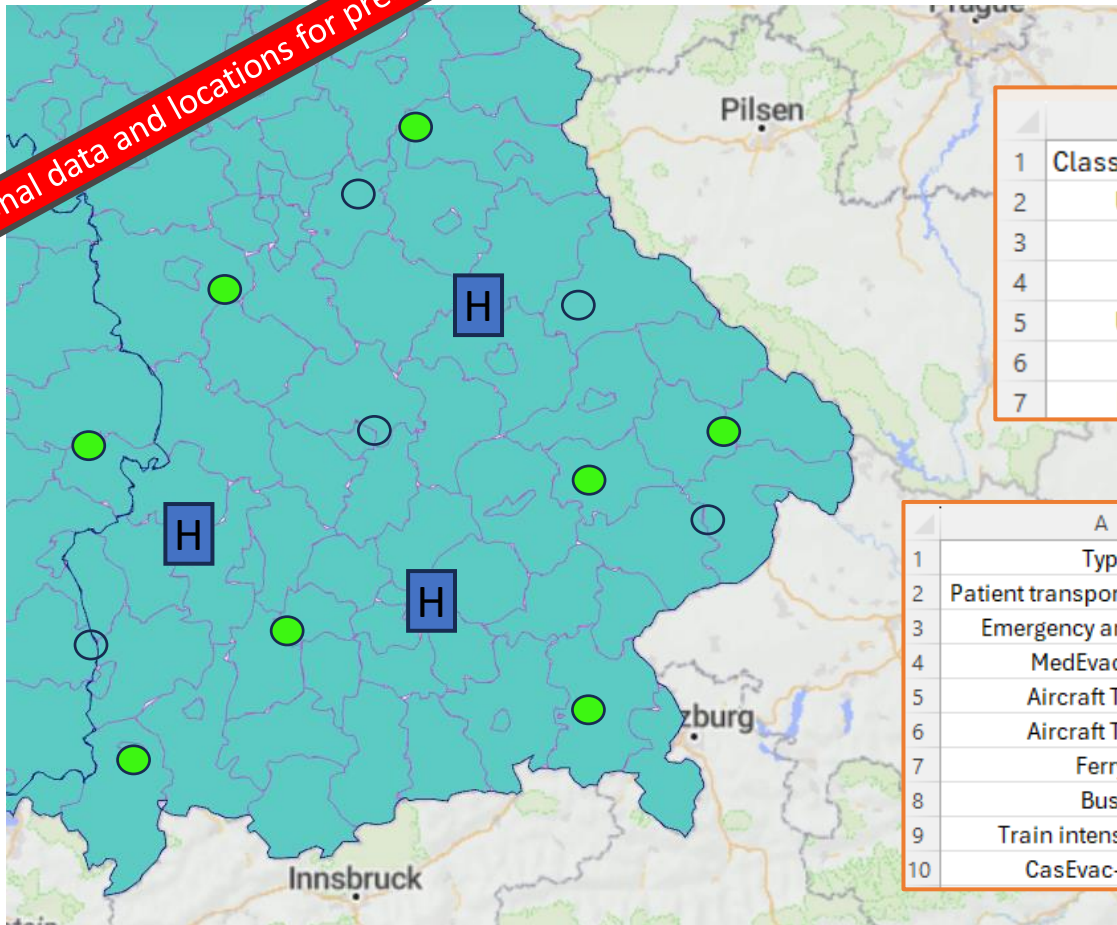
	A	B	C	D	E	F	G	H	I
1	Typ	Speed	Mode	Capa_IC	Cap_Strecher	Capa_Seated	Threshold_total	Threshold_Perfect	Parallel_Loading
2	Patient transport ambulance	60	Road		2				1
3	Emergency ambulance	70	Road	1		1			1
4	MedEvac-Zug	45	Rail	12	90	100	90	90	8
5	Aircraft Type 1	850	Air	8	10	25	18	18	4
6	Aircraft Type 2	850	Air	4	12	25	18	18	4
7	Ferry	15	Sea	40	90	300	240	240	10
8	Bus	60	Road			6	3	3	2
9	Train intensive care	45	Rail	45	0	0	25	25	8
10	CasEvac-Train	45	Rail	0	0	500	225	225	8

A patients path to treatment: POD



A patients path to treatment: National transport

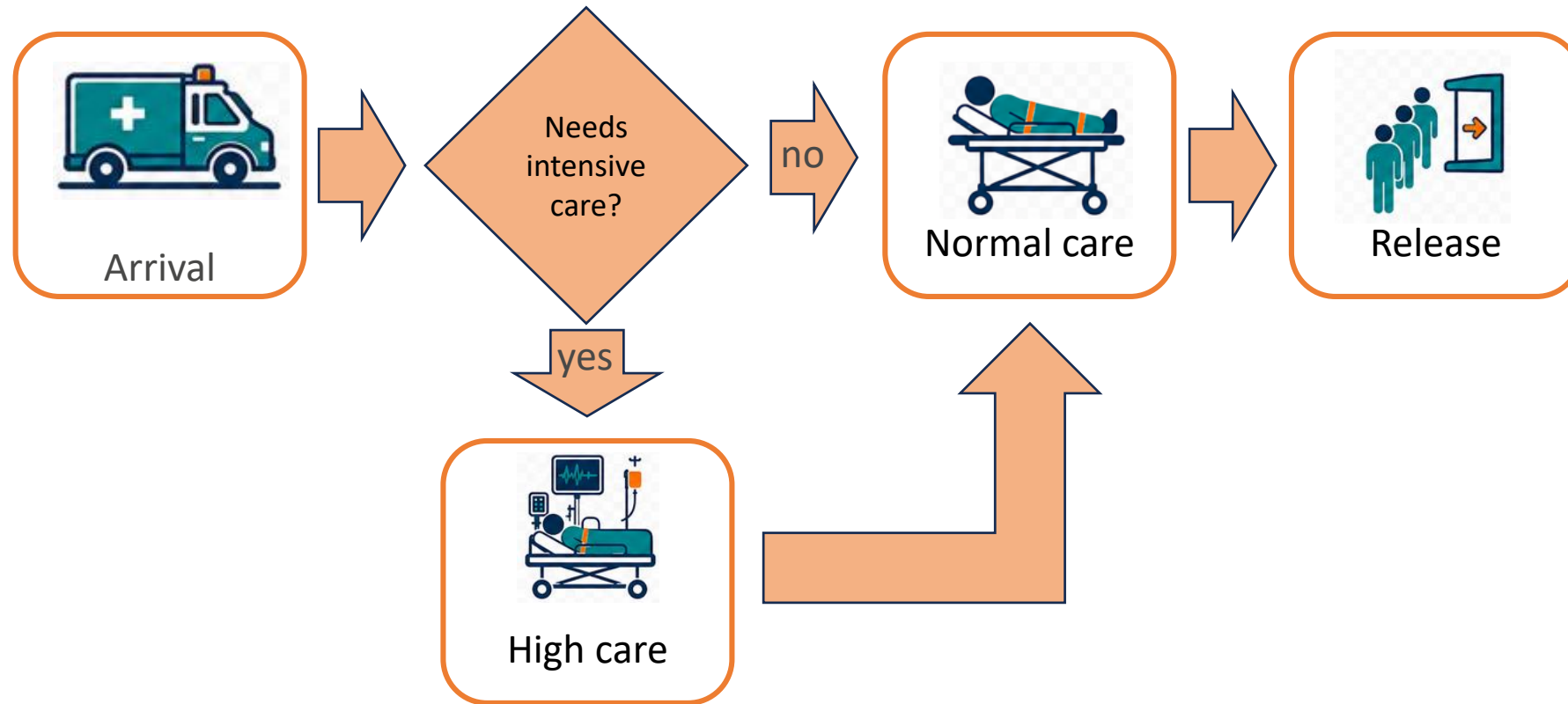
*Fictional data and locations for presentation



	A	B	C	D	E	F
1	Classification	Name	Beds_total	Relevant_Count_NC	Relevant_Count_HC	Capabilities
2	ÜTZ	Hospital 1	473	345	24	
3	LTZ	Hospital 2	356	153	20	Eye
4	LTZ	Hospital 3	220	167	17	
5	ÜTZ	Hospital 4	1354	592	67	Eye
6	LTZ	Hospital 5	234	167	21	
7	RTZ	Hospital 6	268	188	10	Burn

	A	B	C	D	E	F	G	H	I
1	Typ	Speed	Mode	Capa_IC	Cap_Strecher	Capa_Seated	Threshold_total	Threshold_Perfect	Parallel_Loading
2	Patient transport ambulance	60	Road		2				1
3	Emergency ambulance	70	Road	1		1			1
4	MedEvac-Zug	45	Rail	12	90	100	90	90	8
5	Aircraft Type 1	850	Air	8	10	25	18	18	4
6	Aircraft Type 2	850	Air	4	12	25	18	18	4
7	Ferry	15	Sea	40	90	300	240	240	10
8	Bus	60	Road			6	3	3	2
9	Train intensive care	45	Rail	45	0	0	25	25	8
10	CasEvac-Train	45	Rail	0	0	500	225	225	8

A patients path to treatment: Hospitals



Analysis



PATIENT FLOW

- Patient waiting time
- Throughput
- Queue length
- ...



TRANSPORT PERFORMANCE

- Transport time utilization
- Transport capacity occupancy
- Transport availability over time
- ...



CSU, POD & HOSPITAL ALLOCATION

- Patients assigned to each entity
- Load distribution across entities
- Capacity–demand balance
- ...



SYSTEM OUTCOMES & CONDITIONS

- Unserved patients
- Unsatisfied clinical needs
- Hospital policy changes
- ...

Simulation turns data into preparedness

Tests fleet adequacy: Is the vehicle and vessel mix sufficient?

Tests patient distributions: Numbers, injury patterns and transport needs

Tests allocation strategies: Allocation of patients across regions and hospitals

Compares algorithms: Assignment, routing and destination selection

Identifies gaps: Capacity shortages, delays and bottlenecks

Adapts to context: Public or authorized operational data

Evidence-based planning before real operations begin.