Medical Response To A Major Freeway Bridge Collapse

I-35W Bridge Collapse

AUGUST 1, 2007

35W Bridge

- Built 1967
- Rated in recent years as: ‘structurally deficient, but not in immediate need of replacement’
- 2000 ft span, 64 ft high
- 141,000 cars / day
- Mississippi 390 ft wide, avg 7ft depth

Bridge Collapse - Initial

- 6:05pm – entire bridge collapses, first of 49 related 911 calls comes in
- '500 2nd St. SE' is initial address – limited information, unclear which bridge
- First alarm fire response dispatched 6:07pm, Engine 11 arrived 6:12pm, requests 2-2 alarm
- EMS – 1 ambulance and 1 supervisor, dispatch added 2 additional, supervisor and rig 1 arrived 6:13 requested 3-4 additional ambulances
- MFD Deputy Chief requests 'all available' resources

StarTribune

Response Summary

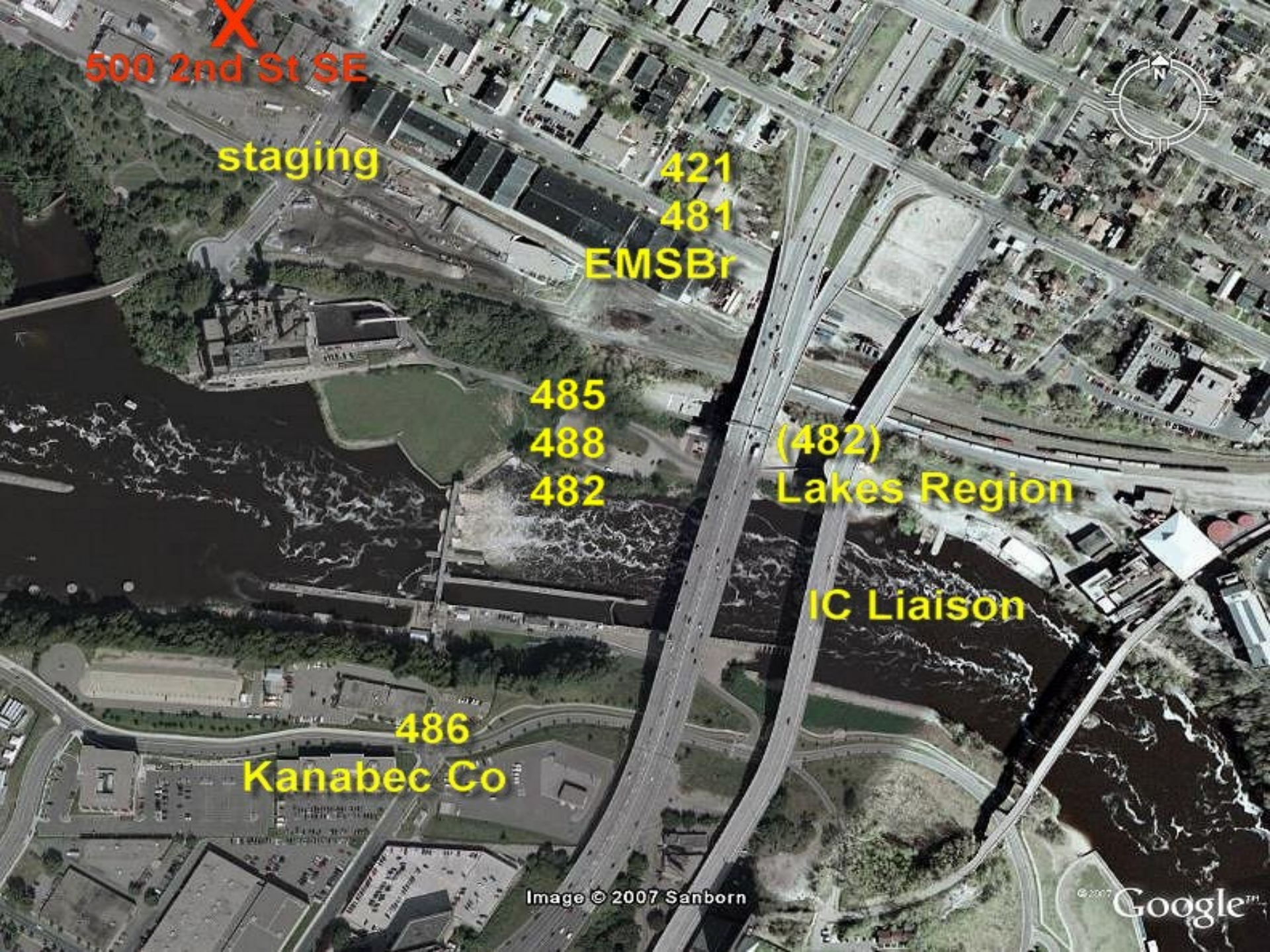
- Collapse to last patient transported:
  - Initial clearing of all sectors: 1 hr 35 mins
  - Last EMS transport: 2 hrs 6 mins
- 50 patients transported by EMS
- 8-13 casualties via other vehicle
- Over 100 patients treated in 24 hours
- 13 deaths
- No serious injuries to first responders
- 29 ambulances used in first 4 hours

EMS Challenges

- Understanding the scene
- Maintaining command
- Sustaining essential communications
- Setting priorities: triage / transportation
- Managing mutual aid response
- Maintaining multiple staging sites
- Coordinating and tracking patient movement
- Overcoming hazards
- Contending with volunteers / self assigned personnel

Scope of Collapse

- Approximately 1 mile of ‘scene’
- Captive to what you could see at the time – no area had a good view of all areas of collapse
- Scope was especially unclear to dispatch centers, also confusion regarding geographic location / which bridge
- Directions were problematic – bridge runs more N/S (most in city are E/W)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500 2nd St SE
staging
421
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EMSBr
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488
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(482)
Lakes Region
IC Liaison
486
Kanabec Co
Image © 2007 Sanborn
Google

INCIDENT
COMMAND

HAZARDS

- Water hazards
- Falling debris
- Secondary collapse / shifting debris risks
- Power lines
- Fires
- Rebar
- Broken Concrete
- Hazardous materials
- Weather

Dispatch Center / MRCC

- Initial alerts to EMS physicians, EMS agencies, and hospitals at 1809h
- 25 updates sent on MnTrac (web-based alerting / resource management system) between 1809h and 2359h
- Only 20% of crews checked in with MRCC
- Crews forgot to use CAD system to status self – rigs 'visible' via GPS but staff location was unclear

MNTrac

Logged in as State Admin

MRCC EMS System Advisory - EMERGENCY

Updated: Thursday 09/28/2006 at 18:09:36 by State Admin

View Report | View Map

Facilities | Regional Status | Knowledgebase | Alert Manager | Command Center | Reports | Settings | Messaging | Logout

- *Demo
- Central
- East Metro
- Northeast
- Northwest
- South Central
- Southeast
- Southwest
- West Central
- West Metro
  - Abbott Northwestern Hospital - Minneapolis
  - Children's Hospital - Minneapolis
  - Fairview Riverside Hospital - Minneapolis
  - Fairview Southdale Hospital - Edina
  - Fairview University Medical Center - Minneapoli
  - Hennepin County Medical Center
    - Facility Summary
    - Resources
    - Pharmaceuticals
    - Staff
    - Facility Setup
  - Mercy Hospital - Coon Rapids
  - Methodist Hospital - St. Louis Park
  - North Memorial Medical Center
  - Queen Of Peace Hospital - New Prague
  - Ridgeview Medical Center
  - St. Francis Regional Medical Center - Shakopee
  - Unity Hospital - Fridley
  - Va Medical Center - Fort Snelling
  - Valley Hospital At Hidden Lakes - Golden Valley
  - WMRCC

MNTrac

Planning a better Minnesota

Regional Status Overview

Location	Open	Caution	Closed
Central	19	1	0
East Metro	11	0	0
West Metro	13	0	2
Northeast	17	0	0
Northwest	13	0	0
South Central	12	0	0
Southeast	13	0	0
Southwest	29	0	0
West Central	10	0	0
*Demo	1	0	0
Statewide	137	1	2

Active Alerts

Report	Alert Type	Created	Updated
	RHRC Hospital Alert	9/28/2006 18:01	9/28/2006 18:10
	MRCC NDMS Bed Count	9/28/2006 18:01	---
	Hospital Surge Capacity Alert	9/28/2006 18:00	9/28/2006 18:09
	MRCC EMS System Advisory	9/28/2006 17:47	9/28/2006 18:09

South Side

- South side
  - Rapid civilian evacuation of span
  - Shifting debris, vehicle fires challenges
  - School bus evacuated, hasty search turned up no additional critical patients
  - Triage area set up
  - Red Cross assistance (right by their building)
  - Staging set up

Center Span

- Most vehicles intact
- Initial water rescues by police and civilians
- 1 CPR on span – terminated efforts on scene
- Few serious injuries on center span
- Multiple evacuated by fire boat to shore
- Current and eddies created by debris, rebar, other hazards

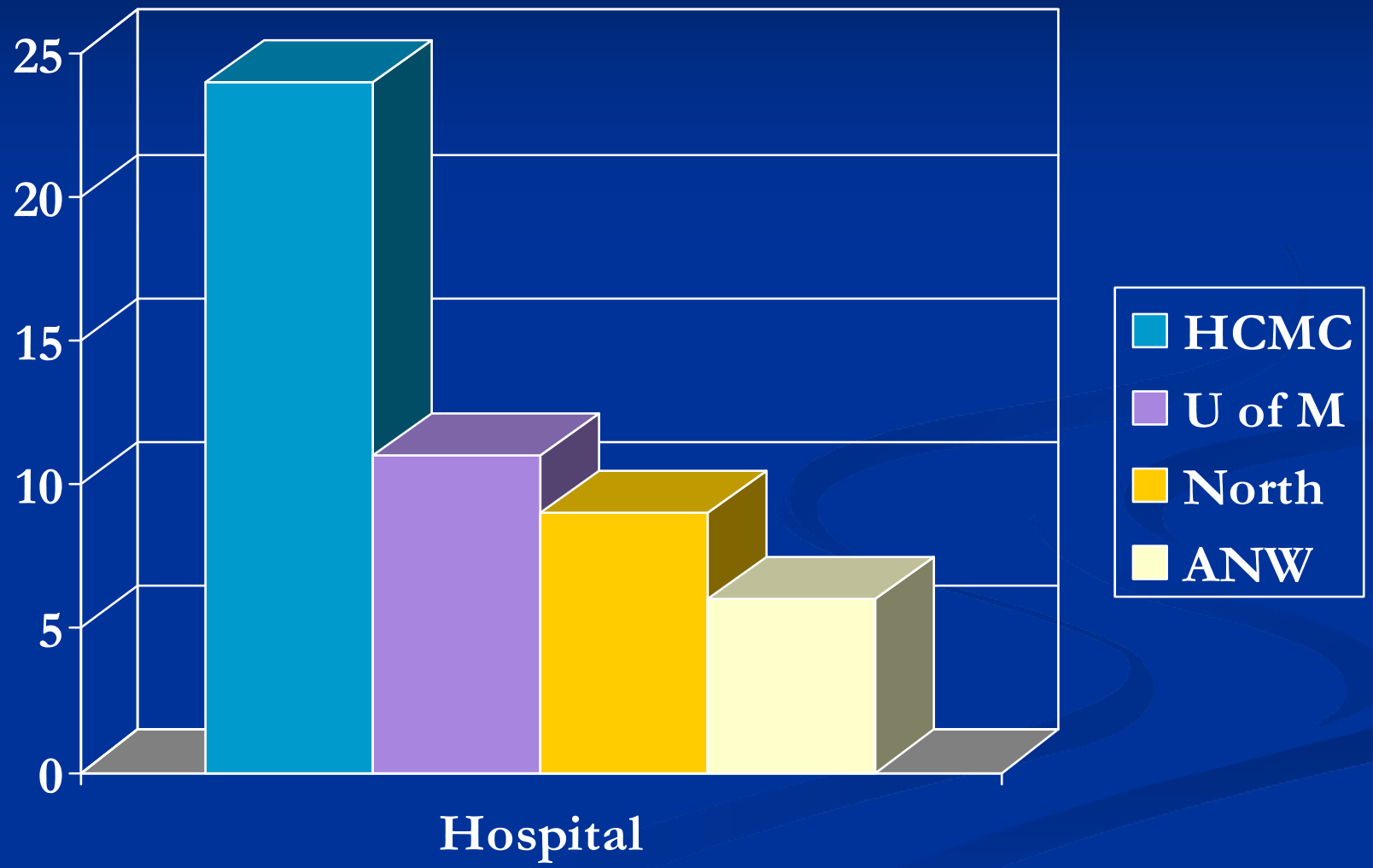
North Side

- Initial critical patients carried on backboards, passed down ladder
- Many bystanders and civilian medical assistance
- No perimeter for first hour
- Pickups used to transport at least 7 victims from N downstream side (limited EMS access), some went directly to hospital (U of M), some intercepted by EMS once reached city streets

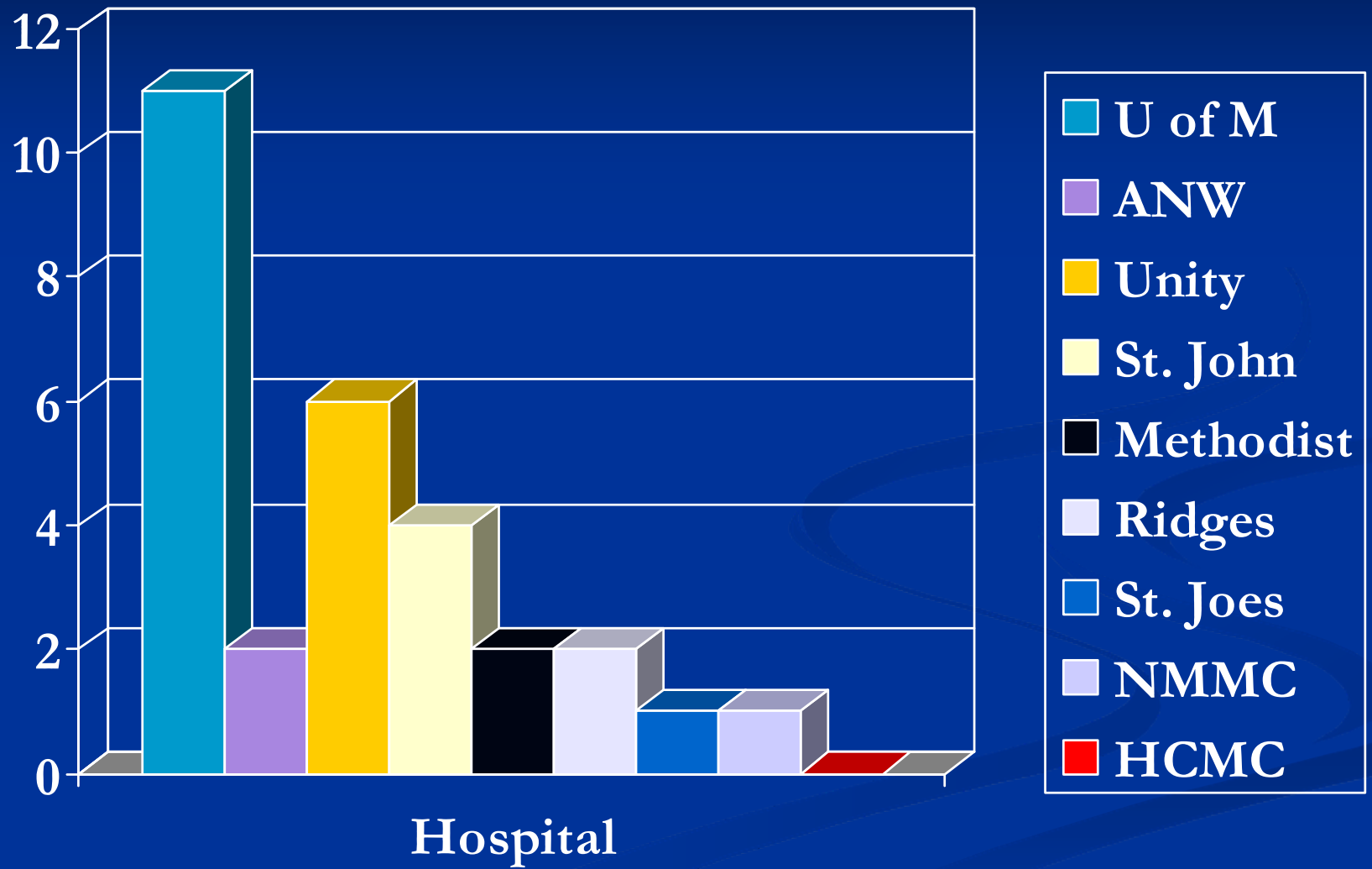
EMS Patient Care

- Priority on rapid extrication and transportation
- Tags used in one collection area, no formal triage system used by medics on scene despite education on START
- 3 IVs established, 1 intubation
- Most received backboards – less C-collars applied due to lack of 'short' collars available
- Only 25% of HCMC transports had sufficient information to bill – all yellow/red patients
- Limited analgesics given – medics had limited morphine on their belt kits

Destination Hospitals - EMS



Destination Hospital – Walk-ins



Delayed Patient Presentations

- Significant numbers following day, tapering next 2 days
- Total 48 additional patients = 127
- 1 admission in this group
- Mainly muscular back / neck pain
- Often behavioral health related (headaches, behavioral issues especially children)

Mitigating Factors

- Weather
- Traffic / lack of forward motion of vehicles
- Use of automobile restraints
- 'Cushion' of bridge collapsing under vehicles and shocks, seats
- Location of event (proximity to hospitals and resources)
- Luck!

Worked well

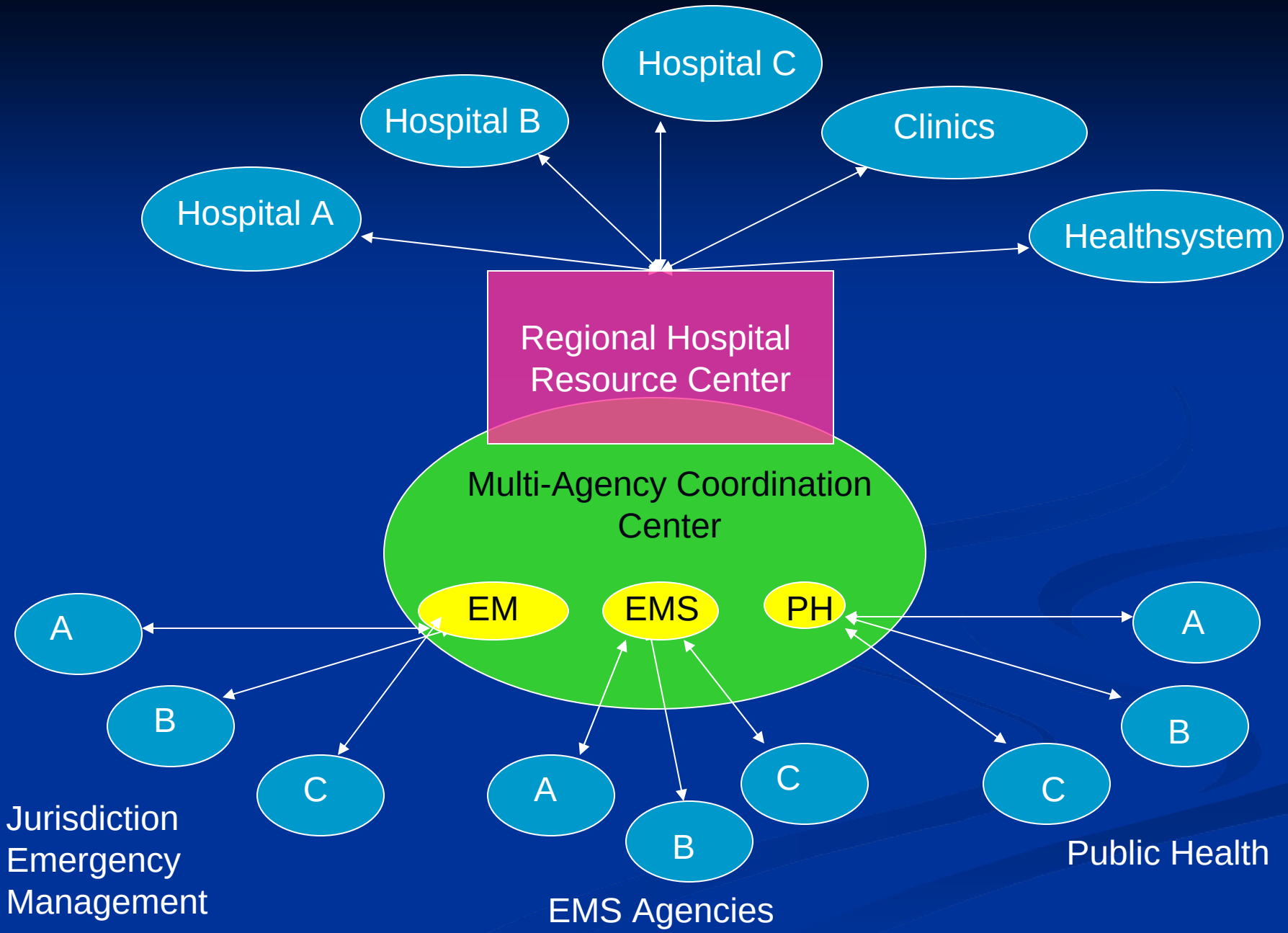
- Regional EMS response plan / mutual aid
- TF-1 collapse rescue team deployment
- Incident management overall
- Civilian assistance (early)
- Public Safety teamwork
- Adaptation to challenges (pickups)
- Communications systems
- Rapid patient care and transport

Could improve

- Situation status / information flow
- Patient tracking
- Ambulance tracking
- Coordination / staging
- Victim tracking and coordination of lists
- Coordination with EOC and multiple agencies needing information
- Crowd control / scene hazard mitigation
- PIO / Media

Regional Baseline

- 2.6 million population
- 24 EMS agencies, 29 hospitals
- HCMC is Regional Hospital Resource Center
- 3 Level 1 trauma centers
- Approximately 5000 acute care hospital beds


Hospital C
Hospital B
Clinics
Hospital A
Healthsystem
Regional Hospital Resource Center
Multi-Agency Coordination Center
EM
EMS
PH
A
B
C
A
B
C
C
A
B
Jurisdiction Emergency Management
EMS Agencies
Public Health

HCMC Response

- Initial information at 6:10pm
  - Hospital near capacity – 5 ICU beds available
  - 2 current critical cases in resuscitation area
- Charge RN turned on TV
- Alert Orange declared at 6:15
- ED staff paged: 'get to HCMC now'
- Initial patients received (critical) at 6:40

Lack of Information

- Most difficult issue in ED was lack of information
- Public saw images before we did
- MRCC was not clear on the extent
- No direct contact with EMS supervisors/MD's from scene to ED
- Unsure if orange alert was needed

Clearing the ED

- Charge Nurse and Staff Physician went to each treatment area and cleared
- Special care used as triage area
- Cleared all of Team A -15 beds
- Cleared all of Team B- 13 beds
- Used Team C and express care for ongoing patients
- Admissions went straight up without delay

Initial 7 Patients at HCMC

	Key Injuries	ISS	Disposition
1	Cardiac arrest	34	Expired
2	Head and abdominal injury	30	OR
3	Abdominal injury	34	OR
4	Head and spinal injury	50	CT - OR
5	Head and spinal injury	17	CT - ICU
6	Abdominal injuries	12	CT - ICU
7	Abdominal injuries	22	OR

HCMC Response

- 25 patients received in 2 hours
  - 1 dead on arrival
  - 6 intubated
  - 5 directly to OR
  - 16 total admissions (60%)
- By 7pm:
  - 25 ICU beds open
  - 10 OR open and staffed
  - 3 CT scanners running

ICU Capacity

- Additional 22 beds opened
  - Transfers from MICU / CCU to stepdown (none required re-transfer)
  - Post-Anesthesia Care Unit beds
  - Cardiac Short Stay unit cleared by discharges or transfers
  - Same-day Surgery (12 beds) was NOT activated – next step in plan
- About 25% of usual capacity added – likely a good initial goal

HCMC Surgical Response

- Nursing
  - Nurse got only halfway through phone list
  - More staff showed up than needed
- 10 OR opened (vs. usual 2-3 on evening/night)
- Surgeons:
  - Surgeons not paged but went to Stabilization Room
  - On-call surgeon was quarterback in Stab Room
  - Junior surgeons operated

Surgical Cases

- August 1, 2007
  - ED thoracotomy (1) (patient died)
  - Craniotomy (2)
  - Laparotomy (2)
  - C-section (1)
  - I&D open ulna/radius fracture (2)
- Subsequently:
  - Takeback for damage control laparotomy (1)
  - Repair facial/mandibular fracture (2)
  - Delayed orthopedic procedure (9)
  - Spinal fixation (3)
  - Trach/PEG (4)

Injury Severity Scores

	Discharged	Admit	Admit ISS range	Admit ISS avg.
HCMC	9	16	1- 50	17
UMMC	14	12	3-14	6
NMMC	6	4	4-14	9.5

Spine Injuries*

- 7/16 patients admitted
  - Three treated operatively
  - Four non-operatively treated
- U of M
  - 7/11 patients
- Mechanism felt to be axial load
- No patients had neurologic deficit

*Greg Sherr, M.D.: personal communication

Surgical Learning

- Drills are important!!!
- Hierarchy and leadership are important Communication
  - Difficult (cell phones broke down)
  - Important!
    - ED to OR, Radiology, SICU
    - OR to SICU, Radiology
- Operations: damage control vs. definitive care
  - Rely on knowing what else is happening
  - Developing alternative communication techniques
- Supplies

Extras

- Metrodome sent all the leftover “Dome Dogs”
- Former chief resident sent pizza
- Sales reps called offering supplies
- Montgomery Regional Hospital (Virginia Tech shootings)hospital sent a signed “Thank you” banner acknowledging HCMC

Hospital Improvements

- Patient tracking
- Communication with scene
- EHR issue
- Hospital phone system education
- Communication within ED, two way radios
- Vocera – not helpful
- Supplies – IV fluids, sux
- More coordinated call in of help
- Paging system to involve surgeons and critical care
- Crowd control in ED
- Media
  - Monitoring
  - Messages to convey
  - Intense media interest

Behavioral Health

- Family support center
  - Unclear delegation of authority = 'semi-unified command'
  - RHRC worked with MRCC to assemble patient lists
  - Psychological first aid support on-site, meeting point, briefings provided
  - Shelter from media major issue
- Staff debriefings – about 22 CISM voluntary debriefings held – many more informal sessions at sites
- Physical / emotional symptoms of responders
- Delayed issues…

Learning and applying

- Structured process
  - Hotwash
  - After-action review
    - Issue identification
    - Issue analysis
    - Corrective Action Plan
  - Follow-up / review plan
  - Exercise

In Memory

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Hanah Mohamed
Christina Sacorafas
Scott Sathers
Artemio Trinidad-Mena
Sherry Engebretsen
Julia Blackhawk
Peter Hausmann
Patrick Holmes
Paul Eickstadt