

“Level One STEMI”

Connecting the Dots changing Points of Care into Systems of Care

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The Eastern Washington Level One program started in 2007

PCI v. Fibrinolytic therapy in AMI: is timing (almost) everything?

Am J Cardiol. 2003; 92: 824–826

“No mortality advantage for primary PCI versus fibrinolytic therapy when door-to-balloon time exceeded door-to-needle time by 62 minutes.”

Goal of thrombolytic by 30 min if patient can not get PPCI
within 90 min of 1st medical contact

Because **Time is Muscle**

but this is “A ONE SIZE FITS ALL”

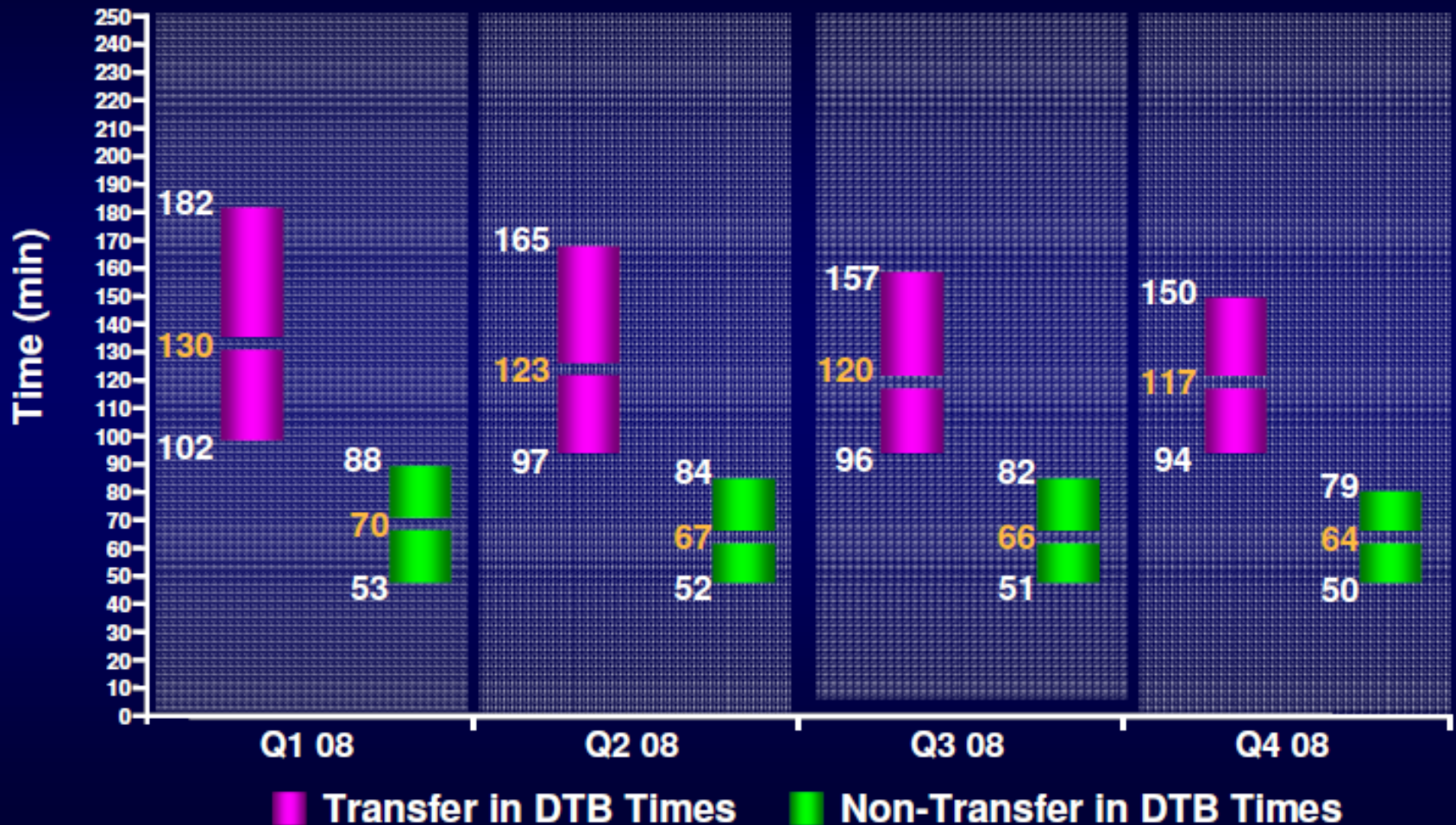
And PPCI safer with better outcomes than lytics

The problem

or why we need to Implement STEMI Systems of Care

- 400,000 STEMI's per year in US
 - half get PPCI by 90 min or lytics by 30 min
- 1 in 7 transfer patients get PPCI by 90 min
 - NRM1 3 & 4 median D2B 180 min
 - NRM1 5 median D2B 143 minutes
 - Action Registry 4th Q 08 D2B mean 117 min
- **10-20% get no reperfusion therapy**

STEMI Door-to-Balloon Times – Median Times for Transfer In and Non-Transfer In Patients



Who makes Treatment Decisions

- Patient & family – (CP, do I go & if so how?)
- EMS – what Dx & where to go? BLS ACLS Paramedic?
- Local ED - High turnover & reluctance to make Dx
“ask permission or forgiveness”
 - Doctors (most are FPs & often an itinerant service)
 - Midlevel Providers (PA or ARNP)
 - RNs (at most 2 & of variable experience & travelers)
- Cardiologist – Whose? The patient’s or provider’s?
 - Call and eventually get a return call

What causes delays?

We like ANW Minneapolis Heart Institute heard,

"that delays to reperfusion occurred while waiting to talk to the cardiologist,"

and

"the recommendations for a specific patient often depended on who the cardiologist was, and the time of day and day of the week."

Site visit done
November 2006

Long-term Outcome of Primary Percutaneous Coronary Intervention vs Pre-hospital and In-Hospital Thrombolysis for Patients With STEMI

JAMA, October 11, 2006

26,205 consecutive STEMI patients in Sweden 1999 to 2004

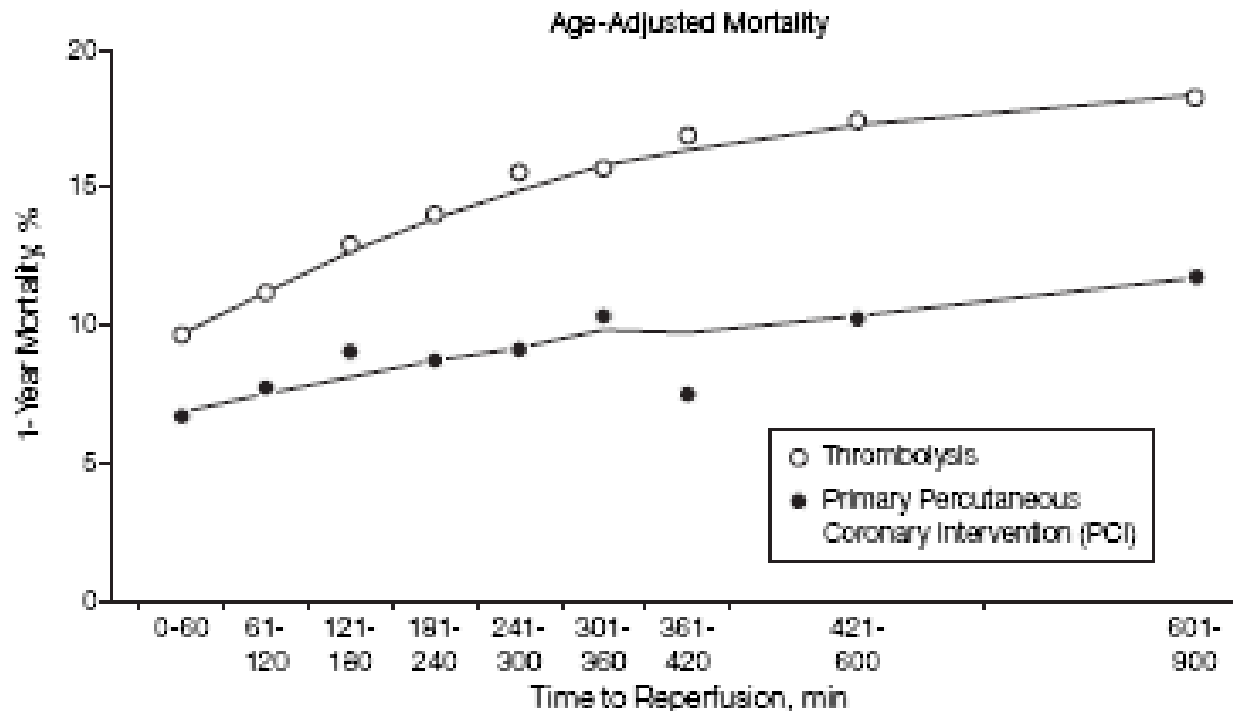
Time counts

	In H Lytic	Pre H Lytic	PPCI
30 day mortality	11.4%	7.6 %	4.9%
1 year mortality	15.9%	10.3%	7.6%

Primary PCI was also associated with shorter hospital stay and less re-infarction than either PHT or IHT.

One year mortality

Percutaneous Coronary Intervention vs Pre-hospital and In-Hospital Thrombolysis



	0-60	61-120	121-180	181-240	241-300	301-360	361-420	421-600	601-900
Thrombolysis									
No. of Deaths	122	503	503	332	239	159	121	196	139
Total No. of Patients	1248	4375	3659	2199	1438	946	658	1061	703
Primary PCI									
No. of Deaths	7	61	91	50	43	37	17	41	31
Total No. of Patients	125	695	1126	776	567	453	282	458	332

Effect of Door-to-Balloon time on mortality in patients with ST-segment myocardial infarction

J Am Coll Card June 2006

29,222 patients presenting within 6 hrs of STEMI symptom onset who had PCI at 395 hospitals.

- **Median D2B of 102 min & inpatient mortality of 4.55%.**
- increasing D2B associated with increasing mortality, regardless of the interval from symptom onset to presentation, or presence of high-risk features.
 - from **3.0%** with D2B of **90 minutes or less**,
 - to **7.4%** with intervals **greater than 150 minutes**.
- The **odds ratio for inpatient mortality was 1.08 for every 30-minute increase in D2B time.**

Association of door-to-balloon time and mortality in patients
admitted to hospital with STEMI BMJ May 2009

Crude mortality rates were (n=43,801)

3.2% for a D2B of < 60 minutes,

3.7% for 60 to 89 minutes D2B,

4.6% for 90 to 119 minutes D2B,

7.7% for > 120 minutes D2B ~ to PreH lytic

(P<0.001 for the trend)

The author's conclusion:

“benefit of reducing D2B for all PPCI patients”

TRANSFER-AMI: 30 day End Points

Both groups got full dose TNK, ASA, LMWH or UFH and
IIb IIIa & clopidogrel at the clinician's discretion

End point	“Standard “ Delayed Transfer 62% rescue or elective PCI	“Pharmacoinvasive” Urgent transfer 84%PCI @ 2-4h after lytics	P
Death	3.6	3.7	0.94
Reinfarction	6.0	3.3	0.044
Recurrent ischemia	2.2	0.2	0.019
Death/MI/ ischemia	11.7	6.5	0.004

Hospital delays in reperfusion for STEMI...

Circulation. 2006; 114: 2019–2025

3 variables: age, type of STEMI, and time of Sx onset

The survival advantage of PCI over Lytics is lost at:

Patients under 65	under 2 hrs	after 2 hrs of Sx
Anterior MI	@ 40 min.	@ 43 min.
Nonanterior MI	@ 58 min.	@ 103 min
Patients over 65	under 2 hrs	after 2 hrs of Sx
Anterior MI	@ 107 min	@ 148 min.
Nonanterior MI	@ 168 min.	@ 179 min.

To benefit more from Primary PCI than IV Lytic given the advantage of PPCI may be lost when DB-DN time exceeds the time shown in the center columns, the time conditions to be met are displayed in the columns on the right:

STEMI	Location	Symptoms Under 2 hr	Symptoms Over 2 hr	Patient must	Balloon inflation
Under 65 yrs	Anterior	40 (give lytic?)	43 (give lytic?)	Arrive By 60 min	By 90 min
	Not anterior	58 (give lytic?)	103	Arrive By 90 min	By 120 min
Over 65 yrs	Anterior	107	148	Arrive By 120 min	By 2.5 hrs
	Not anterior	168	179	Arrive By 2.5 hrs	By 3 hrs

2 “Minimum Decision” Protocol Models

Published in the same issue of *Circulation* Aug 2007

Mayo

based on Symptom Duration

<3 hr Lytic >3 hr PPCI

ANW-MHI

based on Time Delay to PPCI

< 60 m PPCI

> 60 m Lytic then PCI

The Mayo Clinic STEMI Protocol

Presented 1st @ Mayo for Primary PCI

(258) median D2B 71 min. 6.6%

Sx >3 h transferred for Primary PCI

(105) median D2B 116 min. 5.7%

Sx <3 hours full-dose Thrombolytic

(131) median D2N 25 min. 3.1%

In-hospital mortality was “said to be similar”

— but was it?

MHI Level One Program Report Card

3/03-11/06

Circulation Aug 2007

1048 pts transferred in with median D2B time
zone 1 <60 miles 95 m
zone 2 <210 miles 120 m

IN HOSPITAL MORTALITY 4.2%

30 DAY MORTALITY 4.9%

ONE YEAR CARDIOVASCULAR 5.6%

OVER ALL ONE YEAR MORTALITY 7.2%

unselected high-risk patient population with 12.3% in cardiogenic shock, 10.8% cardiac arrest and 14.6% over 80 years age

Concern about Wasted Cath Lab Resources?

MHI Level 1 Program: 1345 patients 2003-2006

14% no culprit vessel & 9.5% with no significant CAD

...but which patient would have benefited from getting Lytics?

Positive biomarker results (n = 64)

Stress cardiomyopathy	17
Myocarditis	15
Previous myocardial infarction	9
ST-elevation myocardial infarction-embolic/spasm	9
Left bundle-branch block	4
Non-ST-elevation myocardial infarction	2
Pulmonary embolus	2
Aortic neoplasm	1
Severe aortic stenosis	1
Drug overdose	1
Unknown	3

Negative biomarker results (n = 123)

Early repolarization	25
Nondiagnostic electrocardiogram	21
Pericarditis	20
Previous myocardial infarction	20
Left bundle-branch block	11
Left-sided ventricular hypertrophy	8
Vasospasm	4
Tachycardia related	3
Right bundle-branch block	3
Pacemaker	3
Brugada syndrome	1
Aortic dissection	1
Unknown	3

Larson DM et al JAMA 298(23), 19 December 2007

Question: How to do
Timely Safe Reperfusion,
& avoid Analysis Paralysis ?

Solution:

Design a protocol based on predetermined
minimum transport times by ground or air
to predict potential of
PCI within 90 +/- 30 minutes

Expedite Reperfusion – “*Minutes is Muscle*”

- “Symptoms to Test” Time
 - Expedite Transport, Triage and ECG
 - Educate the public – perhaps the BIGGEST OPORTUNITY
 - EMS – assessment tool, ECG (ED bypass or “Cardiac Alert”)
 - Expedite ED ECG – ECG by 10 min handed to provider
- “Test to Treatment” Time
 - Empower the ED provider to initiate STEMI treatment
 - “*his patient*” *until arrives at CCL*
 - Standardized Medication Protocols *based on*
 - Predetermined expected transport times for PPCI
 - Empower the ED provider to activate the CCL (*trust*)

Expedite Reperfusion – *“Minutes is Muscle”*

“Test to Treatment” Time

- Stay on EMS stretcher for ECG (& to departure)
- STEMI “tackle box” (drugs & paperwork)
- Minimize interruptions (fewer phone calls)
 - 1 call to activate Transportation, Cardiologist, CCL
- Standardize devices (2 IV heplocks, defib pads)
- Undress patient while waiting (tell what will happen)
- Helicopter skids down to up under 10 minutes
- Information packet for Patient and Family
- 1st bed is Cath lab table (or ER)
 - “Bed ahead” planning

Cardiac Level 1 Protocol Form

- History & Physical exam
- Medications Orders (Checklist)
- H&P Hand off transfer tool is faxed to
 - Paramedic/ACLS transport (Helicopter)
 - Cardiologist & Cath Lab team
 - Admitting
- Performance Improvement Data Tool

Data & Medical History

Transferring Hospital Name Address, ED Phone & Fax number		Soc Sec# _____ DOB _____	
		Admit Date/Time _____ ED Physician _____ (Patient Label)	
CARDIAC LEVEL 1 PROTOCOL for STEMI			
Onset of CP/ Symptoms D&T: _____/____	ED Arrival Time:	Transport to ER via: <input type="checkbox"/> Self/Family <input type="checkbox"/> Ambulance	EKG Time:
			Call to Transport
		Call to Cardiologist: Name:	Depart:
		Arrival:	
PRESENTING CLINICAL DATA/MEDICAL HISTORY - ED Physician and RN to complete			
Age:	Gender: M F	Weight:	Height:
IV Contrast Allergy: <input type="checkbox"/> Yes <input type="checkbox"/> No Discuss w/ Cardiology for Pre-Tx			
Allergies:			
Medications:			
ECG Changes: <input type="checkbox"/> Inferior (II, III, AVF) <input type="checkbox"/> Anterior (V1-V4) <input type="checkbox"/> Lateral (I, AVL, V5-V6) <input type="checkbox"/> Posterior <input type="checkbox"/> LBBB			
Vitals: T	P	R	BP (R) / (L) /
Distal Pulses: R	L	Equal Bilat:	<input type="checkbox"/> Yes <input type="checkbox"/> No
Pain Level (1-10): _____		O2 Sats: _____ @ _____ liters	
If no, comment: _____			
History of CAD: <input type="checkbox"/> No <input type="checkbox"/> Yes		Risk Factors	
Prior MI: <input type="checkbox"/> No <input type="checkbox"/> Yes Date: _____		Smoking: <input type="checkbox"/> Never <input type="checkbox"/> Current (w/ past 12 mos.) <input type="checkbox"/> Former	
Previous PCI: <input type="checkbox"/> No <input type="checkbox"/> Yes Date: _____ Where: _____		Dyslipidemia: <input type="checkbox"/> No <input type="checkbox"/> Yes	
Previous CAB: <input type="checkbox"/> No <input type="checkbox"/> Yes Date: _____ Where: _____		Diabetes: <input type="checkbox"/> No <input type="checkbox"/> Yes	
CHF: <input type="checkbox"/> No <input type="checkbox"/> Yes If yes, clinical symptoms: _____		Family HX CAD: <input type="checkbox"/> No <input type="checkbox"/> Yes	
		HTN: <input type="checkbox"/> No <input type="checkbox"/> Yes	
		Other: _____	
Contraindication to Lytics: <input type="checkbox"/> No <input type="checkbox"/> Yes If yes, comment: _____			
ORDER SECTION		LABS/X-RAY - DO NOT DELAY TRANSPORT FOR RESULTS	
Tropoin LT	CR	H/H	PTT
			Hcg (if child bearing age)
CK-MB	K	Platelets	INR
			Glucose
		Chest XRay	
		Other:	

Treatment Recipe

MEDICATIONS/DOSE	Dosing Comment	TIME	RN INITIAL	MD INITIAL	NOTES
1. Aspirin 324mg PO (four 81 mg chewable) Do not use Enteric Coated ASA	If 324mg taken w/i 12hrs, omit, or augment to total 324mg				Please give NG/PR if pt unable to swallow.
2. Heparin bolus (loading dose) Wt ≤100kg: 60 units/kg IVP (max 4,000 units) *	* Wt > 100 kg: Bolus: 5,000 units IV				
3. Heparin Infusion 12 units/kg (max of 1000units.hr)					
4. Clopidogrel (Plavix) <input type="checkbox"/> 300mg PO <input type="checkbox"/> 600mg PO	Dose with Fibrinolytics (300mg) Dose for Primary PCI (600mg)				
5. Fibrinolytic* <input type="checkbox"/> TNKase IVP per weight as a single IV bolus over 5 seconds. Do not give with any glucose containing solution. OR <input type="checkbox"/> Retavase 10 units IVP, repeat after 30 minutes.	*Door to needle goal <30 min Weight adjusted TNK dosages: Under 60kg/132 lbs: 30mg (6 ml) 60-70kg/132-154 lbs: 35 mg (8ml) 70-80kg/154-176 lbs: 40 mg (8ml) 80-90kg/176-198 lbs: 45 mg (9ml) >90kg or 198 lbs: 50 mg (10ml)				Consider if arrival to PCI center is >90 minutes and no contraindications. See back of sheet for Fibrinolytic indications and contraindications
Administer as needed for pain: 1. Nitroglycerin 0.4mg SL, 1 tab q5 min x3 doses					Hold for SBP <100 Caution in Inferior MI
2. Nitroglycerin IV infusion					Hold for SBP<100, Caution in Inferior MI
3. Morphine Sulfate 2mg IVP, Q 5min. PRN					Hold for SBP<100, RR<8
Last VS: T P R BP (R) / (L) / Pain Level (1-10):		RN Signature:			
ED MD Name: Signature:		Family Contact:		Phone #	
WHEN FORM COMPLETE, FAX WITH LAB/EKG TO: SHMC Cath Lab at (509) 474-5319 & Admission (509) 474-4773 OR DMC Cath Lab at (509) 473-7511 & Admission (509) 473-7306					

Back of Level One Form

- **Thrombolytic Indications**

1. If a Cardiac Level 1 patient can not be delivered to PCI capable facility within 90min of initial presentation.
2. Strongly consider full dose fibrinolytics in the following cases, if there are no contraindications:
 - A) Patient under 65 years of age with an anterior STEMI. OR
 - B) Patient presenting within 2 hrs of symptom onset.

In situations where the decision to administer fibrinolytics is unclear, please consult with the cardiologist prior to administration

- **Contraindications**

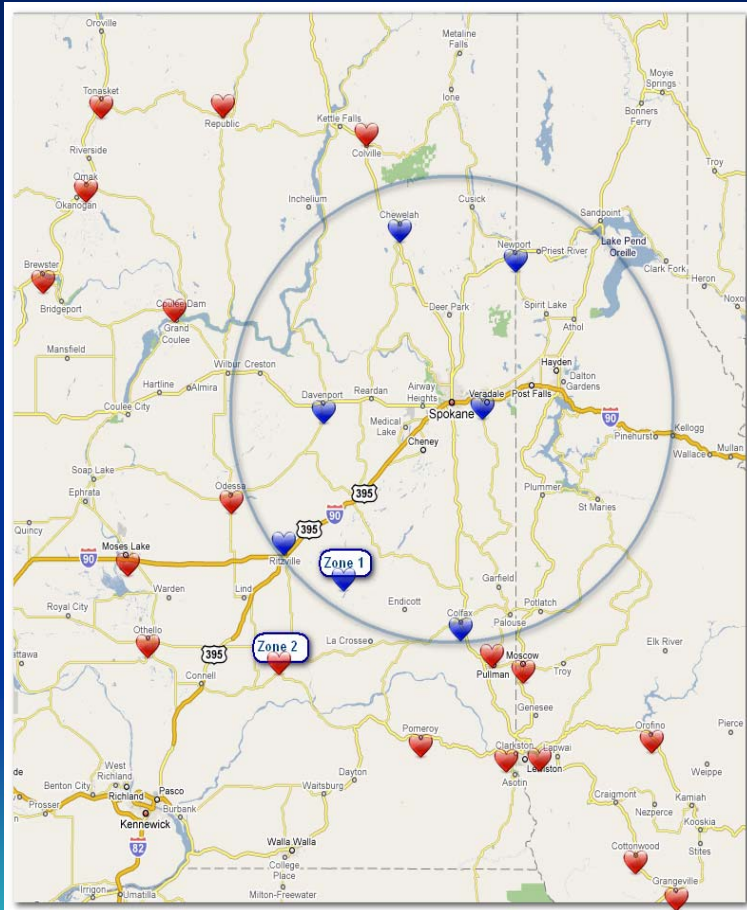
- **Post-thrombolytic guidelines**

Patient Characteristics for choosing initial reperfusion strategy:

- Time elapsed from onset of symptoms to presentation for care?
- What is the patient's age?
- What is the ECG suggested infarct location?
- What is the patient's coronary and renal history?
- Does the patient have contraindications to thrombolytic therapy or contrast?

Can any of these be ignored in a simplified protocol?

Spokane Region Level One Map

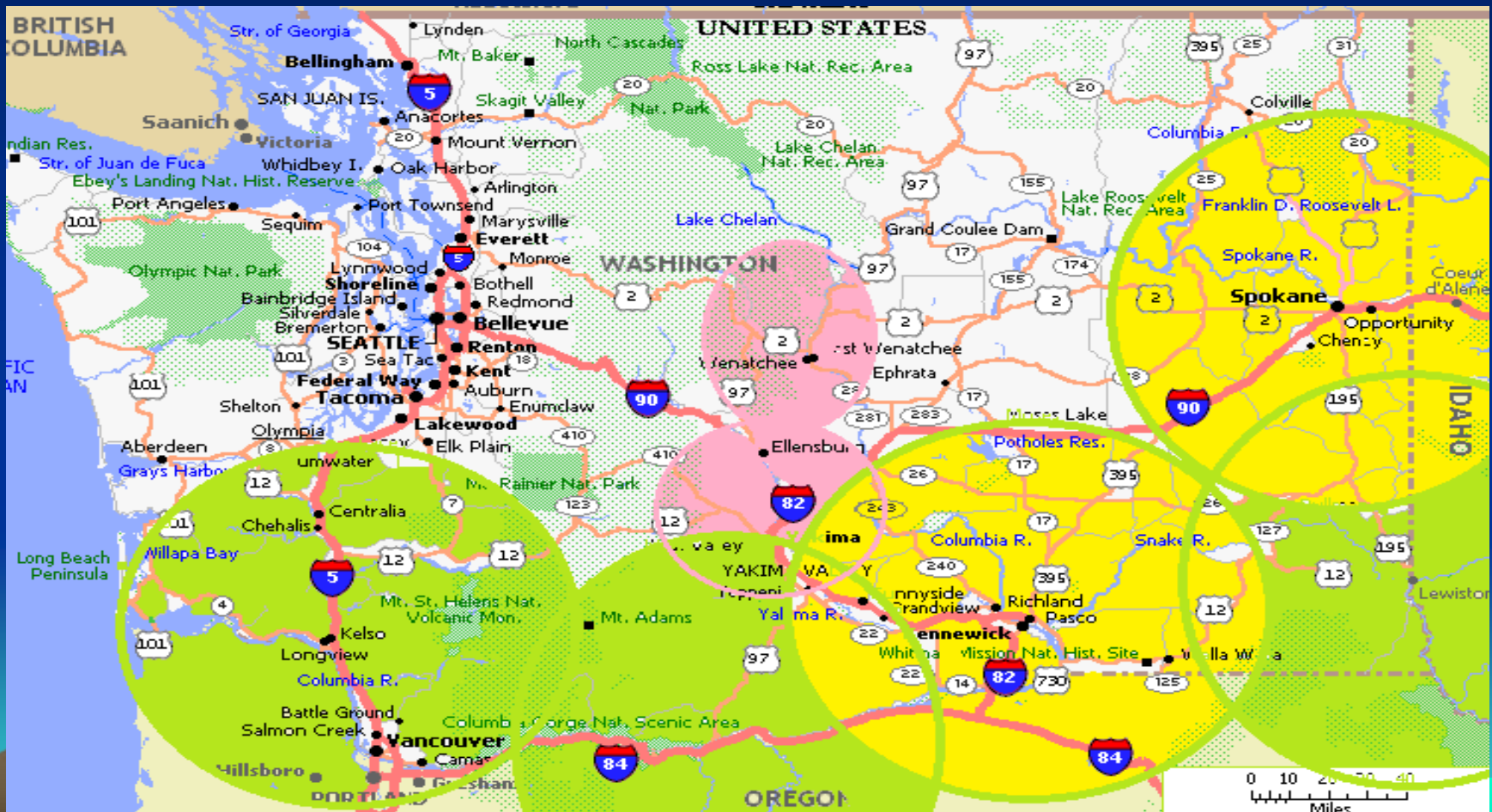


Medstar has helicopters based in Spokane & Tricities

Now Life Flight now has helicopters based in Lewiston, Dallesport & Longview

Both do “Level One” with One Call Dispatch And do standby & autolaunch

Zone 1 time depends on where ACLS EMS & helicopters are based and availability?



Helicopter Flight Team

- Standardized approach to patient care
- Heparin and Tridil infusions prepared enroute outbound
- Focused physical assessment and minimal verbal report
- Pilot to remain in aircraft and <10 min ground time



Difficulties maintaining consistency

- Infrequent STEMI cases
- HIGH Staff turn over
- Variable diagnostic acumen
- Uncertain authority to make Tx Decisions
- Preprinted paperwork forgotten or lost
- Conversion to more sophisticated systems (CPOE, Pyxis) results in loss of flexibility & prior solutions like preprinted orders & STEMI Tackle box

Sustaining the Gain

- Information & constructive feedback
 - EMS, Doctor to Doctor and Hospital to Hospital.
- Culture relationships by communicating promptly and effectively (cudos 2 YRMC)
- Quality Improvement Data Collection with statistical analysis.
- Celebrating challenges & successes
 - Continue state wide development of STEMI care project

Level One process description

A system of care based on trust and mutual respect, empowering the rural providers to 1) make the diagnosis and 2) to initiate a standardized therapy and 3) by single phone call alert the helicopter & Cath lab team as well as ER Charge RN / Security / Chaplaincy / bed control (“bed ahead” or ED holding) etc. and 4) arrange immediate transfer. . The rural provider makes the diagnosis, everything thereafter is “automatic” and time conscious.

If within Zone 1 and an D2B under 90 minutes the patient is not given any thrombolytic (unless an early presenting young patient with anterior infarction). If in Zone 2 (D2B expected over 120 minutes) a full dose of thrombolytic is administered unless there are contraindications. All patients without contraindications get aspirin, 4000 units heparin IV bolus (with a drip if over a half hour transport time), 300mg if lytic or 600mg Plavix if PPCI. Because of limited staff providing care to the rural patient, a distracting telephone “report” is not expected and instead a standardized form is completed and faxed to the cath lab team with the ECGs. Given the known time of transport, the cath lab team knows when they must be ready to receive the patient; and reading the report alerts them to what drugs have been administered and the patient’s condition, and about other support personnel and equipment (vent, respiratory therapy, hypothermia devices, balloon pump, etc.) required. ECG is repeated prior to arrival.

If the patient first arrived at the rural facility on an ambulance stretcher they are left on it until they leave. Two hep lock IVs are started so that dissimilar lines and pumps may be simply plugged in/unplugged and simplify movement of the patient, recognizing that a momentary cessation of a heparin or nitroglycerin drip will not be detrimental. Self adhesive defibrillator pads compatible with the transport defibrillator are placed and the patient’s pants are removed prior to leaving the ER. Monitoring electrodes are not removed until the replacement unit is connected and operating. Helicopters do “hot loads” and highway intercepts. While in transport what is about to happen continues to be discussed with the patient to minimize fear and trepidation. Having received a radio 15 minute “ETA” call, a security officer is waiting to assist movement into the cath lab by holding elevator doors open, and pastoral care is waiting to assist the family. The faxed report has the family’s contact phone numbers and they received brochures, maps and instructions before leaving if not accompanying the patient.

Questions for **every Facility**:

- Have you educated first contact personnel about ACS symptomatology and atypical presentations?
- Have you implemented a “Cardiac Alert” protocol to facilitate your evaluation and initial treatment of potential ACS patients by maximizing your available resources?
- What percentage of your chest pain (and chest pain equivalent) patients have an ECG performed and evaluated within 10 minutes of arrival? How can this be improved?
- Have you established a minimum default treatment recipe for all ACS patients with a customizable preprinted order set with prompts to ensure that all pertinent issues are addressed?

Questions for **Transfer System** :

- What is the probable minimum time from arrival to departure at your facility for a STEMI patient? Do you monitor this? What delays can be identified and avoided?
- What ACLS providers provide cardiac transportation for your patients and how long does it take to assemble a team and for their arrival at your door?
- What is the minimum transfer time to each potential cardiac catheterization capable receiving facility by ground and/ or by air?
- What is the likely minimum total time from arrival at your facility to arrival at the receiving facility; a composite of your time spent in diagnosis and stabilization, waiting for departure and in transport to the referral hospital?

Questions for **Transfer System** con't.:

- Can EMS Transmit or communicate 12-lead ECG information from the field ?
- Do the hospitals and EMS work together to ensure that staff are trained to accurately acquire and read 12-lead ECGs?
- Do you do local ED Bypass on field STEMI ECG?
- Do paramedics administer thrombolytic in field?
- Will the cath lab be activated on field ECG?
- How do hospitals and EMS communicate information on process compliance and STEMI patients outcomes?

Questions about **Cardiology**:

- To whom do you refer acute coronary syndrome STEMI patients? Which physicians and what institutions? How meaningful and timely is the feedback received on cases transferred?
- How is the referral made? Whom do you call and how many calls are required? How can the referral / transfer process be streamlined and simplified?
- What is the expected cath lab arrival to balloon inflation time for your transferred patients? What is their average time currently and what are the percentages under 90 & 120 minutes? How does it change by time of day, day of week, and practitioner?

It is not the *strongest* of the species that survive, nor the most intelligent, but the one most responsive to change.
- Charles Darwin

