CRITICAL CARE RESUSCITATION UNIT (CCRU)

University of Maryland Medical Center's Innovation to Optimize Outcomes for Inter-facility Transfers with Non-Trauma Time Sensitive Critical Illness

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R Adams Cowley Shock Trauma Center
University of Maryland

FINANCIAL DISCLOSURES

Discovery-Program in Emergency Preparedness (SCCM and USCIIT)
- HHS BARDA/FDA funding
- Protocol co-chair, Steering Comm member and Site PI

Ventec Life Systems
- Novel ventilator multi-therapy device
- Financial relationship
- Clinical Advisory Board member

Philips/ Respironics
- Novel ventilator
- Consultation
- Scientific Advisory Board member

I have received speaking honoraria and travel support from academic medical centers and academic professional societies.

TIME SENSITIVE STROKE CARE

- Early EMS notification and recognition
- Pt transported to Primary Stroke Center
- Rapid ED recognition and CT
- Left prox MCA (hyperdense M1)
- TPA given (70 min after onset)
- Transfer request to Comp Stroke Ctr for possible endovasc intervention
  - Delayed due to no NCCU bed
  - Sent to ED without full crit care recs, transfer med direction, or adequate commo with Brain Attack to streamline eval/ resus/ time to neuro IR

TYPE A AORTIC DISSECTION

- 52 y/o woman with HTN presents to a community hospital with chest pain, tearing sensation to back

Braverman, Circulation, 2012.

- Referral request
- Accepted by cardiac surgeon
  - OR not aware of pt prior to arrival
  - Several ongoing CS cases
  - No hemodynamic management recs to referring physician or transport team
- No CSICU bed so delayed transfer until arrangements made for ED or direct OR transfer
- Pt dies prior to arrival

MYRIAD OF TIME SENSITIVE NON-TRAUMA TRANSFER NEEDS

TIME-SENSITIVE EXAMPLES

- **Acute Care Emerg Surgery**- surgical sepsis, hemorrhage
- **Cardiology**- MI, post arrest
- **Cardiac Surgery**- ascending aortic emergencies, cardiogenic shock including high risk & massive PE, acute valvular dysfunction
- **Neurology**- Stroke care (especially neurovasc intervention)
- **Neurosurgery**- atraumatic SAH
- **Oncology-** acute leukemia requiring immediate interventions
- **Respiratory Failure**-multi-specialty eval for advanced resp care including ECMO
- **Transplant**-fulminant hepatic and acute on chronic hepatic failure
- **Vascular**- Acute occlusion, pseudoaneusymal and aneursymal hemorrhage

THE ARGUMENT FOR REGIONALIZATION

Pro

- Vol:Outcome relationships
  - Structure
  - Process
- Qualified provider shortages
- Reduce redundancy of costs for entire catchment area
- Structure for organizing system and standard processes
  - Referring and receiving facilities

Con

- Access
- Concentrating expertise
- May overburden receiving facilities
- Financial implications for referring and receiving hospitals
- Potential transport hazards
- Family impact due to distance from home
- Possible information gap regarding patients previous medical care as well as post discharge handoff potential for communication failure

POTENTIAL BENEFITS OF INTERHOSPITAL TRANSFERS

TABLE 4. POTENTIAL ANNUAL MORTALITY REDUCTION IN EIGHT STATES UNDER REGIONALIZED SYSTEM OF ADULT CRITICAL CARE

		By Originating Hospital Location*		
Variable	All Hospitals	Large Urban	Small Urban	Rural Area
Population at low-volume hospitals	83,050	57,862	20,673	4,515
Number transferred†	74,357	51,804	18,451	3,975
Number of accepting hospitals	283	283	283	283
Potential lives saved,‡ mean (95% range)	4,720 (2,522–6,744)	3,253 (1,632–4,896)	1,153 (671–1,659)	284 (120–465)
Number needed to move to save one life,‡ mean (95% range)	15.7 (11.9–29.6)	16.0 (10.8–32.7)	16.0 (11.5–27.3)	13.8 (9.2–31.4)
Travel distances between hospitals, miles, median (IQR)	8.5 (4.0–21.2)	6.4 (3.4–12.7)	23.3 (10.8–47.2)	56.6 (47.4–78.7)

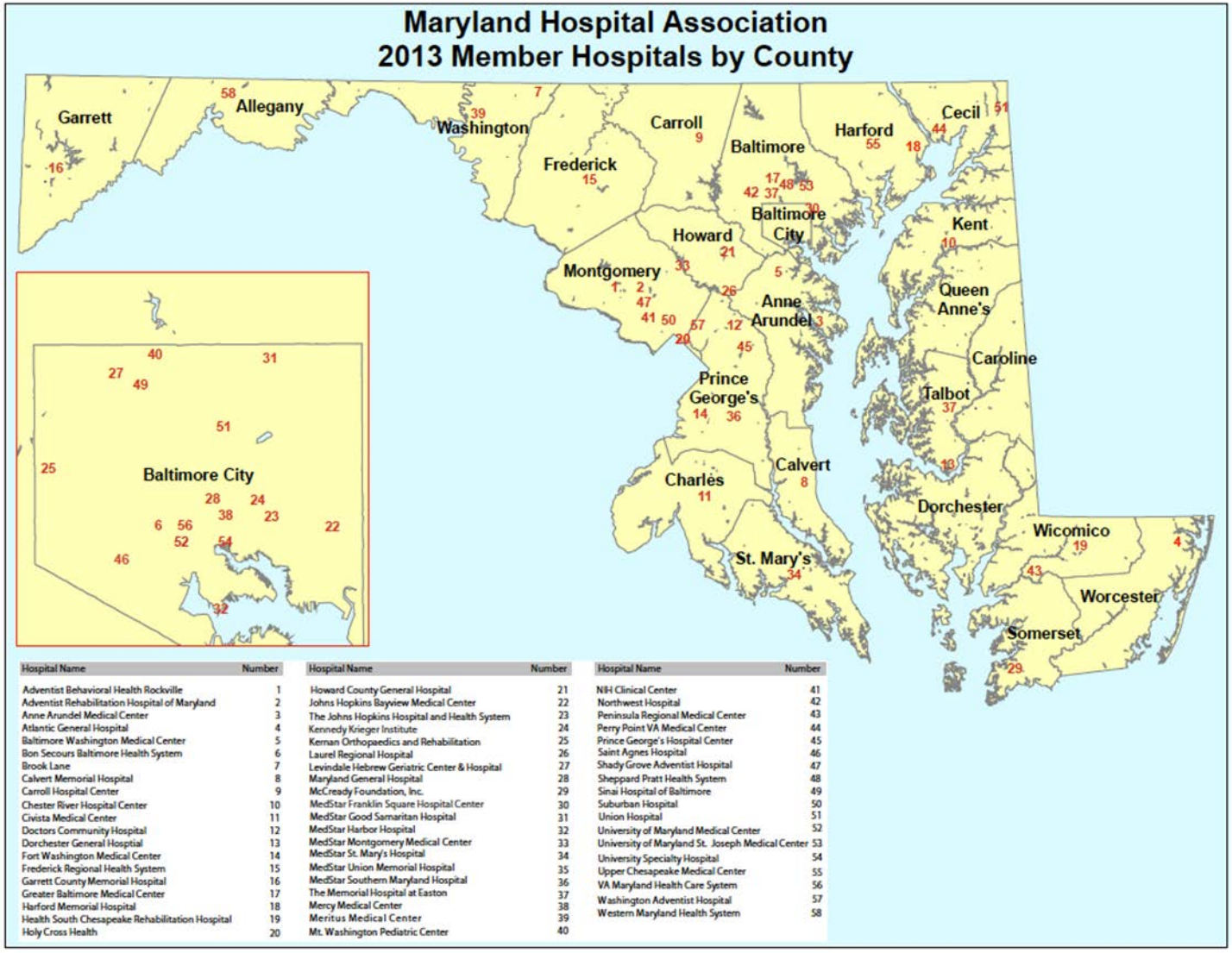
Kahn JM et al. AJRCCM 2008.

CURRENT STATE OF INTER-HOSPITAL TRANSFERS

1 in 20 Medicare crit care stays currently involve interhospital transfers

ADD IMAGE OF TRANSFER NETWORKS

MARYLAND HOSPITALS: VARIABLE LEVELS OF RESOURCE AND CAPABILITY



Hospital Name	Number
Adventist Behavioral Health Rockville	1
Adventist Rehabilitation Hospital of Maryland	2
Anne Arundel Medical Center	3
Atlantic General Hospital	4
Baltimore Washington Medical Center	5
Bon Secours Baltimore Health System	6
Brook Lane	7
Calvert Memorial Hospital	8
Carroll Hospital Center	9
Chester River Hospital Center	10
Civista Medical Center	11
Doctors Community Hospital	12
Dorchester General Hosptial	13
Fort Washington Medical Center	14
Frederick Regional Health System	15
Garrett County Memorial Hospital	16
Greater Baltimore Medical Center	17
Harford Memorial Hospital	18
Health South Chesapeake Rehabilitation Hospital	19
Holy Cross Health	20

Hospital Name	Number
Howard County General Hospital	21
Johns Hopkins Bayview Medical Center	22
The Johns Hopkins Hospital and Health System	23
Kennedy Krieger Institute	24
Kernan Orthopaedics and Rehabilitation	25
Laurel Regional Hospital	26
Levindale Hebrew Geriatric Center & Hospital	27
Maryland General Hospital	28
McCready Foundation, Inc.	29
MedStar Franklin Square Hospital Center	30
MedStar Good Samaritan Hospital	31
MedStar Harbor Hospital	32
MedStar Montgomery Medical Center	33
MedStar St. Mary's Hospital	34
MedStar Union Memorial Hospital	35
MedStar Southern Maryland Hospital	36
The Memorial Hospital at Easton	37
Mercy Medical Center	38
Meritus Medical Center	39
Mt. Washington Pediatric Center	40

Hospital Name	Number
NIH Clinical Center	41
Northwest Hospital	42
Peninsula Regional Medical Center	43
Perry Point VA Medical Center	44
Prince George's Hospital Center	45
Saint Agnes Hospital	46
Shady Grove Adventist Hospital	47
Sheppard Pratt Health System	48
Sinai Hospital of Baltimore	49
Suburban Hospital	50
Union Hospital	51
University of Maryland Medical Center	52
University of Maryland St. Joseph Medical Center	53
University Specialty Hospital	54
Upper Chesapeake Medical Center	55
VA Maryland Health Care System	56
Washington Adventist Hospital	57
Western Maryland Health System	58

UNIVERSITY OF MARYLAND MEDICAL CENTER

- 757 inpatient beds
- 35K inpatient admissions/yr
  - approx 11K are transfers
  - Many transfers are critically ill or require immediate intervention
- Busy surgical subspecialty services
  - Vascular, Cardiac Surgery including Aortic Center
  - Acute Care Emergency Surgery (ACES), Neurosurgery and Liver Transplant have large emergency practice
  - Soft Tissue service is major referral site for necrotizing STIs

- Comprehensive stroke center
- Lung Rescue Unit

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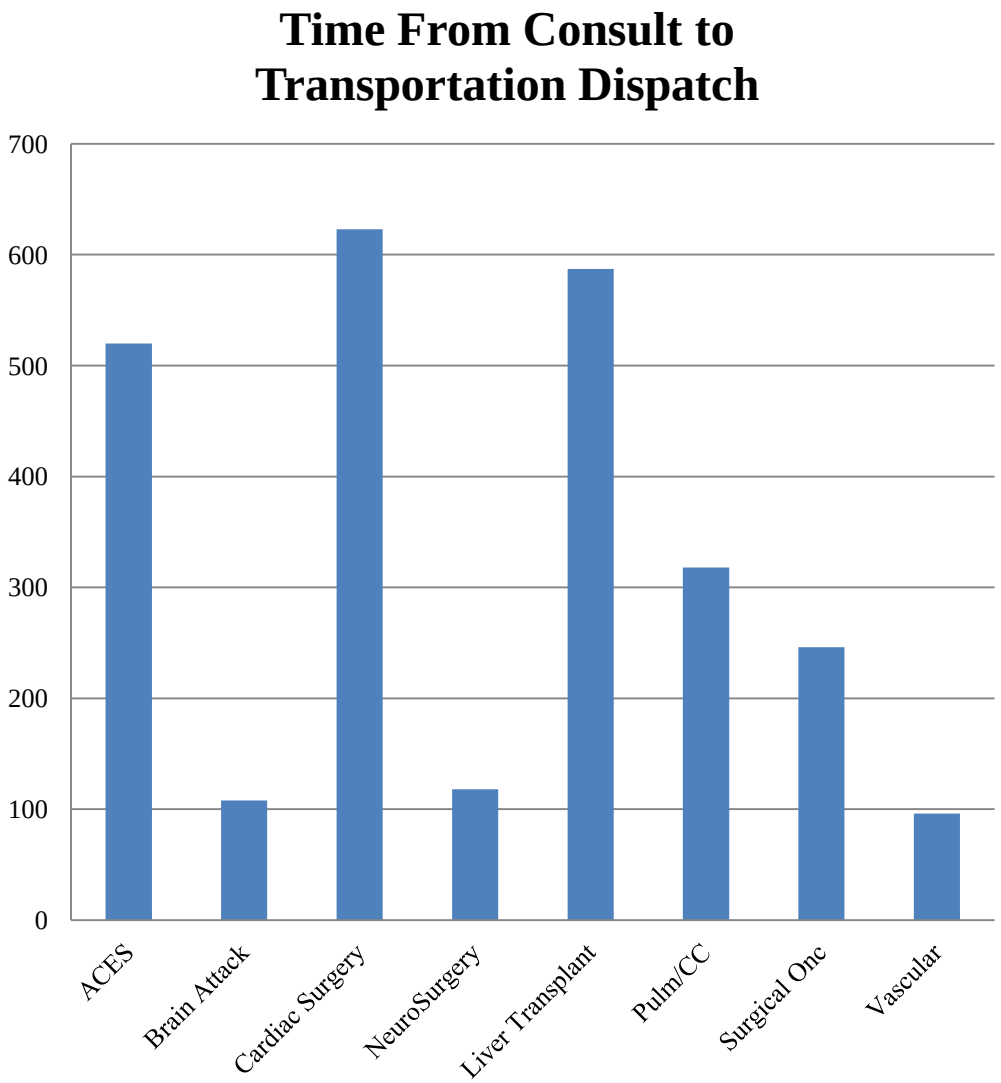
FY 2013: PATIENTS UNABLE TO ACCESS UMMC INPT SERVICES

Service Line/ Specialty			JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUN FY12	FY 13 Y.T.D.	FY 12 Y.T.D.	VARIANCE	% Variance
UMMC	Maryland Heart Center	Cardiology	1	0	2	4	3	2	6	6	4	1	0	1	0	**30**	23	7	30%
		Cardiac Surgery	0	1	1	2	1	4	1	3	1	1	1	0	2	**16**	17	(1)	-6%
	Maryland Neurocare	Neurology	3	2	5	4	1	9	14	5	6	4	4	1	2	**58**	48	10	21%
		Neurosurgery	15	18	13	11	6	12	12	9	16	9	10	6	4	**137**	168	(31)	-18%
	Maternal	Obstetrics & GYN	4	5	2	4	0	1	0	0	0	0	0	3	0	**19**	18	1	6%
	Medicine	Pulm. Crit. Care	11	3	7	7	3	9	23	19	9	9	5	3	2	**108**	91	17	19%
	Surgery	ACES	2	5	4	0	1	3	2	2	2	1	1	3	1	**26**	29	(3)	-10%
		Vascular	2	2	3	1	1	0	1	3	1	0	1	2	2	**17**	17	0	0%
		Transplant	0	1	0	1	0	0	0	0	0	0	1	0	0	**3**	6	(3)	-50%
		Thoracic	0	0	2	0	0	2	1	0	2	1	0	0	0	**8**	2	6	300%
		Orthopaedics	1	0	3	0	0	0	0	0	0	1	1	0	0	**6**	4	2	50%
		Oral Maxillofacial	1	0	0	1	0	0	0	1	0	0	0	0	0	**3**	3	0	0%
		Otolaryngology	2	2	2	0	1	1	7	2	1	0	3	0	0	**21**	9	12	133%
		Plastics	1	1	0	0	0	0	0	0	0	0	0	0	0	**2**	1	1	100%
		Urology	1	1	1	0	0	0	0	0	0	0	1	0	0	**4**	1	3	300%
R Adams Cowley Shock Trauma Center			19	17	7	2	4	0	4	2	2	2	5	3	4	**67**	63	4	6%
Greenebaum Cancer Center			1	1	0	1	1	0	0	3	0	1	0	1	0	**9**	14	(5)	-36%
Total Lost Admissions			**64**	**59**	**52**	**38**	**22**	**43**	**71**	**55**	**44**	**30**	**33**	**23**	**17**	**534**	**514**	20	**4%**

- Most Neurosurgery, ACES, Pulm, and Neurology were unable to access due to unavailable ICU beds.
- STC lost admissions were usually isolated non-life threatening or not time-sensitive injuries

FY'13 DELAYS TO TRANSFER EVEN FOR THOSE WHO ARRIVED AT UMMC



RECEIVING UNIT WHEN PRIMARY LOCATION UNAVAILABLE

Service	Service Primary Unit(s)	Cross Boarding Unit	# of Occurrences of Cross Boarding	JUNE	*Total for Service*
Neurosurgery	Neuro ICU, 4 IMC, C5	SICU	10		**109**
		MICU	14	2	
		Med Flr	6		
		ED	3		
		STC	76	5	
Brain Attack	ED, Neuro ICU, 4 IMC	SICU	3		**40**
		MICU	9		
		STC	26	2	
		Med Flr	2		
Cardiac Surgery	CSICU	CCU	8		**39**
		MICU	2		
		SICU	3		
		STC	26	2	
Thoracic Surgery	SICU, SIMC, W5	STC	7		**15**
		CSICU	2		
		C5	0		
		Med Flr	6		
ACES	SICU, SIMC, W5	STC	58	1	**133**
		Med Flr	23	3	
		C5W	31		
		C8	10	1	
		C6W	11		
Vascular Surgery	SICU, SIMC, C5	STC	34	1	**46**
		CSICU	2		
		W5	5	1	
		C6E	1	1	
		C8	4		
Oncology	N8W, BMT, MICU	STC	2	1	**16**
		W6C	1		
		Med Flr	13	2	
Neurology	Neuro ICU, 4 IMC, C5, ED	MICU	4	1	**20**
		STC	11		
		Med Flr	5		
Organ Transplant	SICU, SIMC, C8	Med Flr	57	3	**69**
		W5	1		
		STC	11	1	
Total Occurrences of Cross Boarding for FY 13				27	**448**

Some alternate admission sites had no problems, but sites were generally not designed nor had detailed, deliberate processes for alternate types of patients

INTER-FACILITY TRANSFER VOL FOR SELECTED SPECIALTY SERVICES

We need a unit to get surgical critical care pts, especially with aortic emergencies to UMMC 24/7

Always at the ready

	FY '09	FY '13
	59%	7
ry	37%	4
cal Care	51%	8
Neurology	35%	3
Transplant	27%	3
Vascular	38%	3

We need to grow our tertiary/ quaternary services to enhance our clinical, training, and research missions

THE DILEMMA: BUILDING ADDL CAPACITY BY SPECIALTY NOT THE ANSWER

- Emergencies are not uniformly distributed across time
  - To be able to always receive pt, some excess capacity must be maintained
- Addl capacity needed for all key programs
  - Multiplier very costly
- BUT, Additional capacity would need to be constantly utilized for sustainability
  - FTE costs, equipment costs, etc
  - May dilute acuity due to availability
- Negative impact of delay to ICU care/ OR has been documented in a number of studies
  - How about delay to perform key processes even within ICU or OR?
  - It may not be about ICU but instead time-sensitive requirements
- ICU workflow not necessarily conducive to receiving emergencies 24/7

TRAUMA AS THE MODEL

We know how to build this

We already do this, but now we'll do it for non-trauma shock

Prehospital coordinated system and standardized training/protocols
Use speed when appropriate
Real-time med direction to push STC expertise field-forward

Appropriate anticipatory posture

TRAUMA RESUSCITATION UNIT (TRU)

Saying “yes” too all in need is crucial

-But-

Its not just about volume…The TRU is not just a landing zone…

It’s a Resuscitation Unit skilled in provision of full-spectrum trauma management

TRU EXPERIENCE

Never say “no” to referring facilities with sick trauma patients

24/7 attending trauma surgeon providing pre-hospital medical control and consultation to referring clinicians

Entire TRU process developed to optimize time-sensitive evaluation and appropriate interventions

All staff (nurses, RTs, anesthesia, Radiologists and Xray techs, techs, clerks) are trained/experienced for trauma patients

Able to manage all anticipated trauma needs in optimal timelines

Critical Care Resuscitation Unit (CCRU)

Applying the Shock Trauma model to non-trauma time sensitive critical illness

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NEW WAY FOR NON-TRAUMA TIME-SENSITIVE CRITICAL ILLNESS

Build a system for ensuring time-sensitive tertiary/quaternary critical care needs get immediate access to UMMC

Link referring facility and transport team data to anticipatory posture of receiving unit

Standardize processes for rapid resuscitation and life-saving intervention

Active management of patients' subsequent disposition (OR, ICU, downgrade, etc)

- Short duration (goal 6-12 hrs, shorter for operative emergencies)

CRITICAL CARE RESUSCITATION UNIT (CCRU)

6 beds

24/7 Attending intensivist/ APP dedicated coverage

Dedicated nursing team

Roles/responsibilities/training of clerical and clinical techs fully integrated

- Requirements-driven rather than disease-specific
  - "Competency" in myriad of time-sensitive eval, procedures, diagnostic processes, organ support
- Deliberate coordination of consultation, transportation, pre-arrival posture, early eval and resus, intra-hosp transfers and QA/QI
- All non-trauma surgical subspecialty critically patients transferred to UMMC
- Model: 6-12 hrs dispo to definitive ICU, faster if dispo to OR

WHY IS THE CCRU NOVEL?

- On the surface the CCRU looks like an ICU
  - Uses ICU rooms in STC tower
- Procedures and equipment similar to ICUs
  - However, equipment is what you would see across all adult ICUs
    - EVD, cont EEG, IABP, V-A ECMO, PA cath, prone positioning, V-V ECMO, CRRT, MARS, REBOA, wound vac/ open abdomen
- Community access mission
  - Workflow optimized not only for current pts but next consult and inbound patients
- Optimized communication
  - Referring facility
  - Prehospital transport
  - Receiving ICU, ward or OR
- Anticipatory posture
- As many resources as needed are used for admission
  - Defined roles/ responsibilities
- Specialist can focus on eval, early intervention since CCRU team takes care of hemodynamics/ metabolic derangements

THE INITIAL CONSULTATION

MARYLAND EXPRESSCARE (MEC)

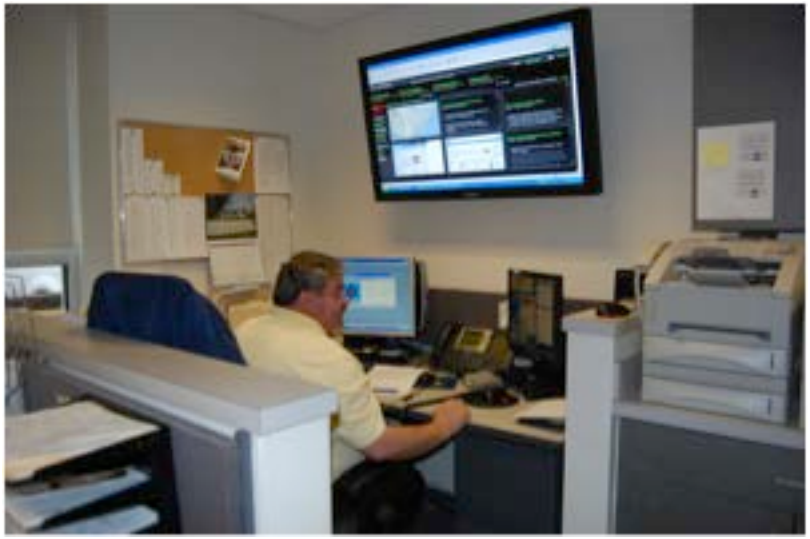
Staffed 24/7

16 FTEs

Comm Ctr Coordinators are EMT trained

Recorded lines for quality monitoring

GPS/computer assisted dispatch



11,000 transfers/yr

20+ yrs in existence

1. Subspecialty attending paged
2. CCRU attending has direct phone
3. Subspecialist determines if transfer is warranted (usually in consultation with CCRU)
4. CCRU determines if CCRU is warranted
   - All surgical critical care pts come to CCRU
     - CSICU and SICU do not take direct transfers any more
   - Neuro, neurosurg, MICU overflow
   - If need time sensitive procedure will still bring even if not critically ill (e.g. limb ischemia)
5. Management recs provided when applicable
6. Transport modality also recommended

CHALLENGES NOT JUST ABOUT CAPACITY OR TIME TO TRANSFER

Prior to July 2013:

- Receiving ICUs had no standard means to gather and disseminate pre-arrival data from referring and Express Care
- Response to pt arrival was typically reactive rather than anticipatory and proactive
- Some ICUs w/o 24/7 attending intensivist coverage
- No means to rapidly enter patient orders if crashing patient arrived and problem with registration system
- Limited means to rapidly review outside imaging
- No standard prioritization schema if transfers had addl rapid imaging needs
- Transfers frequently came at bad time for ICU work flow

TRANSFERS ARE LIKE A BOX OF CHOCOLATES

Many reasons why pt's condition may be different on arrival from what was conveyed on consultation call

Sources of pre-arrival data to ensure:

- Safe transport
- Arrival anticipatory posture

1. Initial consult
2. Chesapeake Regional Information System for our Patients (CRISP)
   - MD statewide
3. Referring nurse: receiving nurse report
4. MEC ground or PHI air team pre-departure call to CCRU attending
   - 80-90% of CCRU transfers

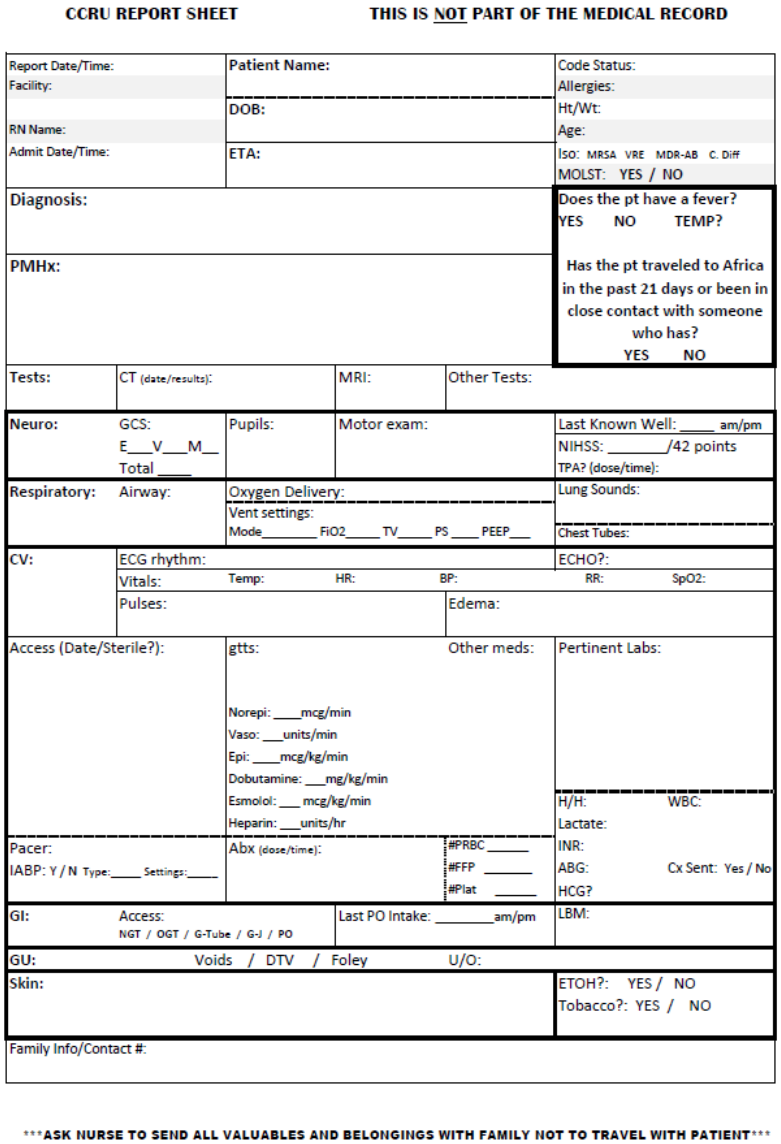
ENSURING CARE STARTS AS EARLY AS CAN BE SAFELY ACCOMPLISHED

Pushing CCRU/ UMMC subspecialty care goals to referring hospitals

- e.g. BP control in SAH due to unsecured aneurysm or Type A dissection (HR control as well)
- We ensure things are started asap
  - Did they initiate our recs from consultation (nursing report and transport med direction call)

Based on physiology and equipment needs we provide deliberate recs for best transport means for pt

- Ground vs air
- Advanced capability (e.g. full-feature vent, inhaled vasodilator) vs speed



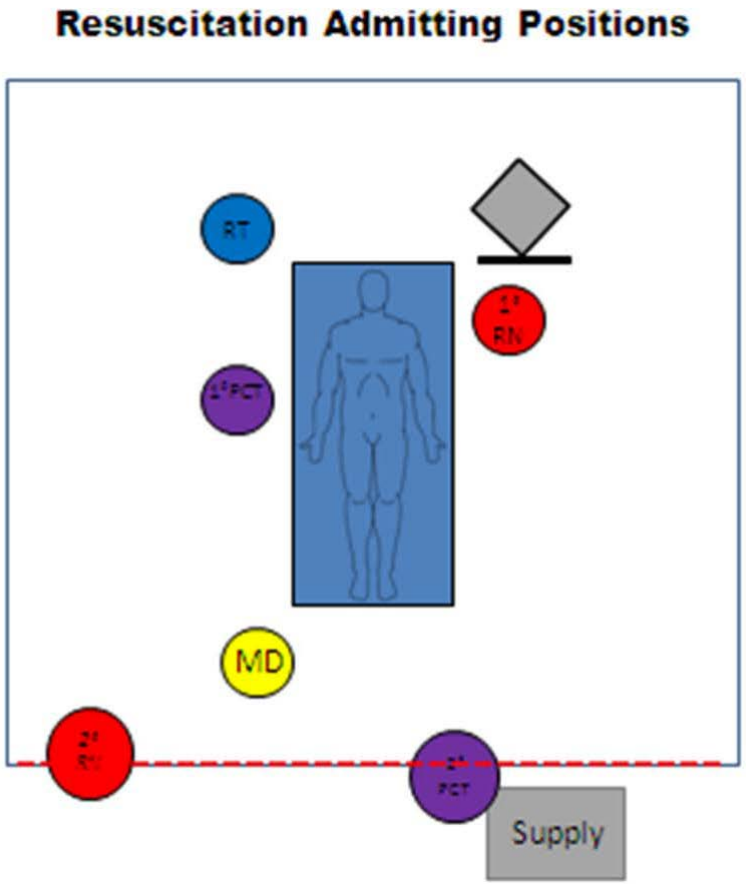
CCRU REPORT SHEET **THIS IS NOT PART OF THE MEDICAL RECORD**

Report Date/Time: Facility: RN Name: Admit Date/Time:	Patient Name: DOB: ETA:	Code Status: Allergies: Ht/Wt: Age: ISO: MRSA VRE MDR-AB C. Diff MOLST: YES / NO
Diagnosis: PMHx:		Does the pt have a fever? YES NO TEMP? Has the pt traveled to Africa in the past 21 days or been in close contact with someone who has? YES NO
Tests:	CT (date/results):	MRI: Other Tests:
Neuro:	GCS: E___V___M__ Total ____	Pupils: Motor exam:
		Last Known Well: ____ am/pm NIHSS: _____/42 points TPA? (dose/time):
Respiratory:	Airway:	Oxygen Delivery: Vent settings: Mode_____ FiO2____ TV____ PS ____ PEEP___
		Lung Sounds: Chest Tubes:
CV:	ECG rhythm:	ECHO?:
	Vitals: Temp: HR: BP: RR: SpO2:	
	Pulses:	Edema:
Access (Date/Sterile?):	gtts: Norepi: ___mcg/min Vaso: ___units/min Epi: ___mcg/kg/min Dobutamine: ___mg/kg/min Esmolol: ___ mcg/kg/min Heparin: ___units/hr	Other meds: Pertinent Labs:
		H/H: WBC: Lactate:
Pacer: IABP: Y / N Type:____ Settings:____	Abx (dose/time):	#PRBC _____ #FFP _____ #Plat _____
		INR: ABG: Cx Sent: Yes / No HCG?
GI:	Access: NGT / OGT / G-Tube / G-J / PO	Last PO Intake: _____am/pm
		LBM:
GU:	Voids / DTV / Foley	U/O:
Skin:		ETOH?: YES / NO Tobacco?: YES / NO
Family Info/Contact #:		

ASK NURSE TO SEND ALL VALUABLES AND BELONGINGS WITH FAMILY NOT TO TRAVEL WITH PATIENT

ACUTE RESUSCITATION FRAMEWORK

- Roles and responsibilities of all CCRU staff for resuscitating a critically ill patient
- Criteria for initiation
- Criteria for de-escalation
- Minimize chaos



EXAMPLES OF CCRU PATIENTS

Vascular

aortic emergencies, acute ischemic limbs, pseudoaneurysmal hemorrhage

Cardiac Surgery

aortic emerg, massive PE, acute need for CABG, endocarditis, acute flail mitral valve, V-V ECMO for resp failure, V-A ECMO for cardiogenic shock

Acute Care Emergency Surgery

life-threatening intra-abd pathology, massive GI hem, severe pancreatitis

Soft Tissue

necrotizing fasciitis

Neurological

acute CVA post TPA, status epilepticus, AIDP

Neuro Surgical

Non-traumatic SAH, ICH, acute paralysis

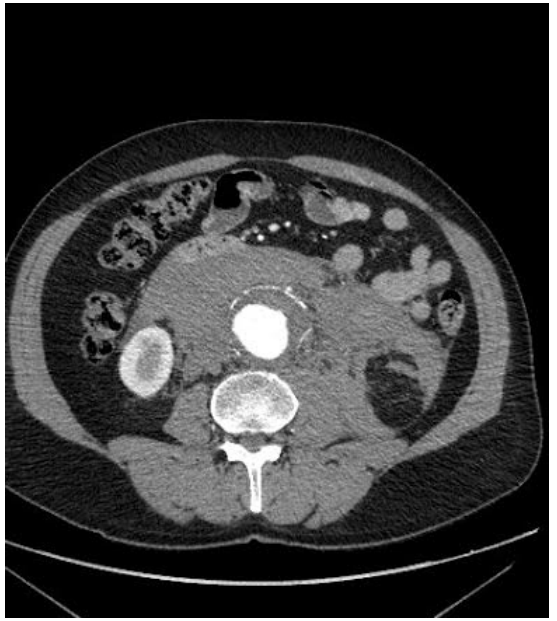
Cardiology

cardiogenic shock, post-arrest, Pulm HTN, severe arrhythmias

Obstetrics

life threatening peri-partum hemorrhage, amniotic fluid embolism

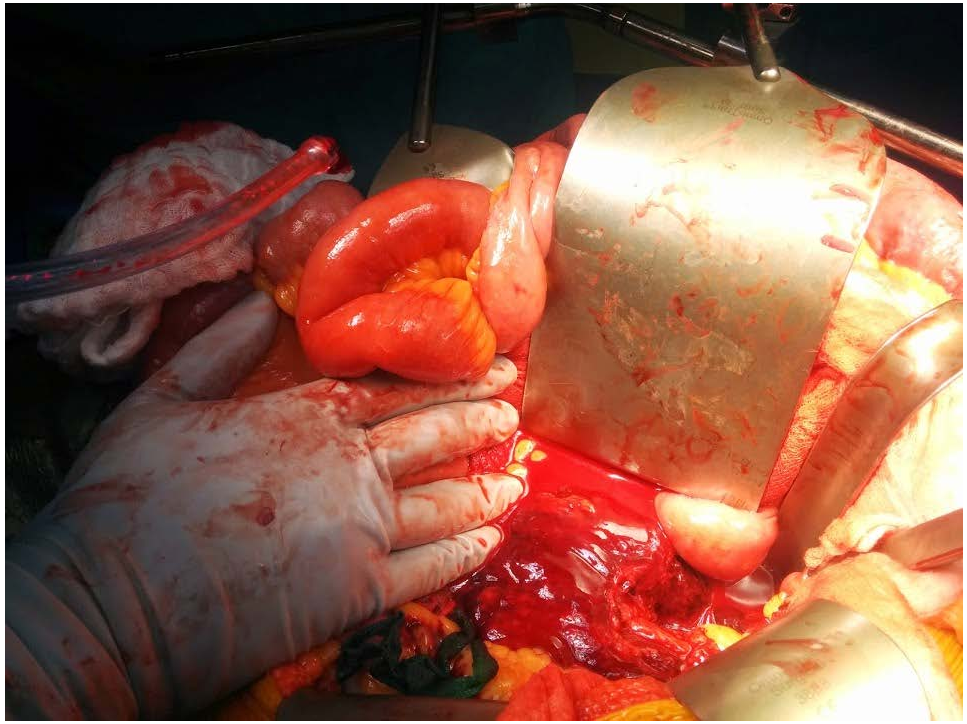
CCRU ANTICIPATORY POSTURE AND RAPID RESUSCIATION



INFRARENAL AAA W/ CONTAINED RUPTURE

CCRU Interventions

1. Endotracheal tube intubation
2. Right IJ MAC cath insertion
3. Right radial a-line
4. Transfer to OR and near immediate skin incision



CCRU COMMON INTERVENTIONS

1. Severe sepsis and septic shock resus
2. Massive hemorrhage resuscitation
3. ICP management
4. Complex ventilator management, (“rescue therapies” for refractory resp failure)
5. ECMO cannulation and management
6. Invasive hemodynamic monitoring and IABP management
7. Renal replacement therapy

Less commonly used, but available

1. REBOA
2. Minnesota tube placement
3. Plasmapheresis
4. MARS
5. Hemoptysis temporizers (endobronchial blockers)
6. In-room operative procedures (decompressive lap)

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CCRU NURSES- A TRULY SPECIAL GROUP

Terri Dinardo- CCRU nurse manager (also TRU manger)

- Selected charge nurses with extensive and varied crit care experience

CCRU mission requires wide breadth and deep depth of expertise

- Must provide care with competency of each specialty ICU

TIME-SENSITIVE NON-TRAUMA TRANSFERS & LOST ADMISSIONS

Table 1. Nontrauma, Adult Critical Care Transfers and Lost Admissions to the University of Maryland Medical Center

Variable	2011–2012 ICUs	2013–2014 ICU/CCRU	2013–2014 CCRU	p Value
Total critical care transfers, n	1,354	2,228	1,318	
Mortality, n (%)	224 (16.5)	365 (16.4)	193 (14.6)	0.31
Length of stay, d (excludes in-hospital mortality), median (interquartile range)	8 (4–15)	8 (4–15)	9 (5–16)	0.059
Lost admissions, n	469	363		
Lost admissions/total critical care referrals, %	25.7	14		<0.001
Clinical service, n				
Acute care emergency service	57	161	155	
Cardiac surgery	157	225	202	
Neurosurgery	219	375	222	
Orthopaedics	2	10	10	
Surgical ear, nose, throat	6	4	4	
Surgical oncology	1	13	13	
Thoracic surgery	23	14	12	
Transplant surgery	14	52	47	
Vascular surgery	40	143	140	
Urology	0	8	8	
Other*	835	1,223	505	

*Numerous clinical services, including cardiology, medicine, neurology, and pulmonary critical care.

Scalea T et al. J Am Coll Surg 2016.

TOTAL CCRU PT VOLUME

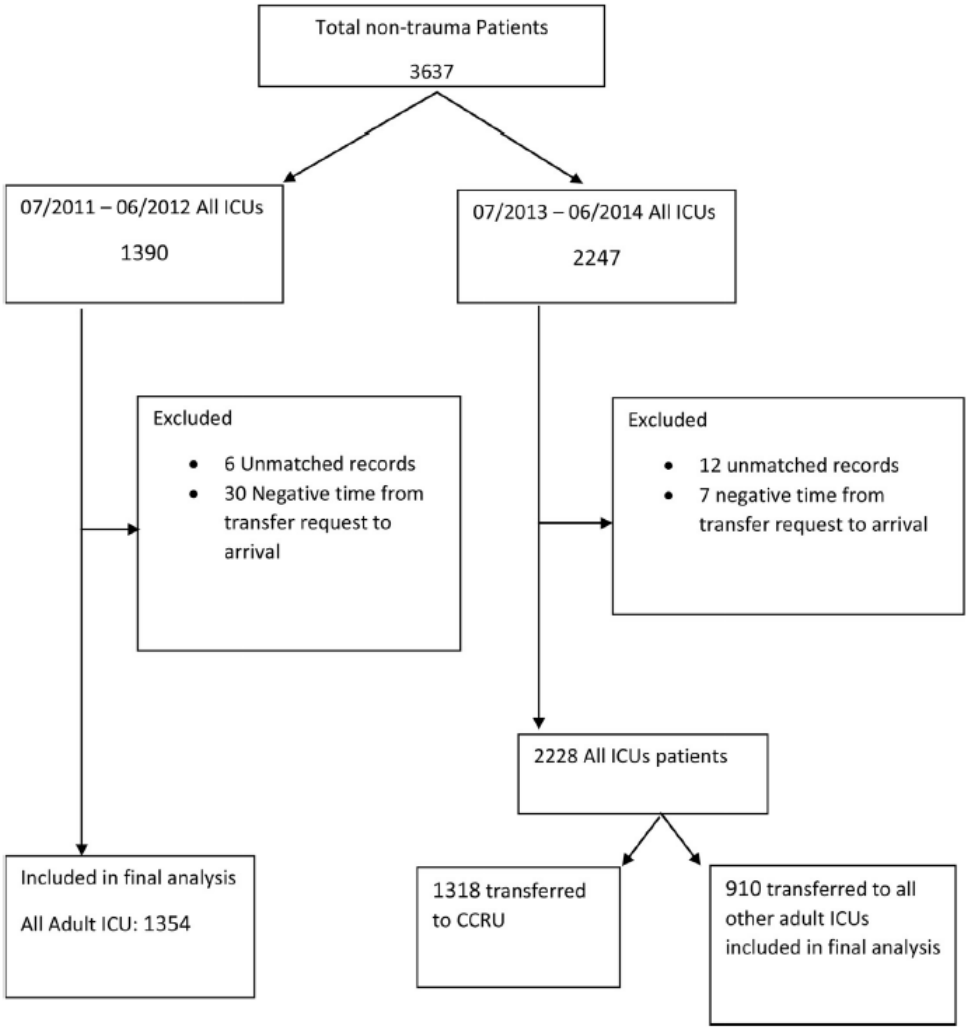


Figure 1. Critical care resuscitation unit (CCRU) flow diagram.

- 134 soft tissue pts
- 138 Trauma pts
- 244 inpt deterioration w/o available ICU bed

CCRU ASSOCIATED WITH EXPANSION OF SEVERAL KEY PROG

UMMC cardiac surgery is highest vol program in MD

3rd busiest adult ECMO program in US

- 60% V-V, 40% V-A
- ~ 170 cases/yr

~ 170 liver transplants/yr

FASTER ARRIVAL

Table 2. Timing and Outcomes of Critical Care Transfers to the University of Maryland Medical Center: Pre vs Post-Critical Care Resuscitation Unit

Variable	2011–2012 Transfers to adult ICU	2013–2014 Transfers to CCRU	p Value
n	1,354	1,318	
Deaths, n (%)	224 (16.5)	193 (14.6)	0.27
Time from consult to arrival, min, median (IQR)	234 (142–418)	129 (85–236)	<0.001
Hospital LOS, d (excluding deaths), median (IQR)	8 (4–15)	9 (6–16)	0.01
CCRU LOS, h, median (IQR)	NA	9 (4–20)	
Patients operated during hospitalization, n (%)	421 (31.1)	605 (46)	<0.0001
Deaths, n (%)	65 (15.4)	77 (12.7)	0.25
Time from consult to arrival, min, median (IQR)	223 (146–406)	118 (76–200)	<0.001
Time from arrival to incision, min, median (IQR)	3,424 (927–9,752)	1,133 (323–5,195)	<0.001
Hospital LOS, d (excluding deaths), median (IQR)	17 (10–28)	13 (8–23)	<0.001
Patients operated within 12 h of arrival, n (% of operations)	90 (21.4)	248 (41)	<0.0001
Deaths, n (%)	13 (14.4)	31 (12.5)	0.78
Time from consult to arrival, min, median (IQR)	166 (118–258)	106 (67–155)	<0.001
Time from arrival to incision, min, median (IQR)	318 (192–489)	262 (177–446)	0.105
Hospital LOS, d (excluding deaths), median (IQR)	13 (7–26)	13 (7–21)	0.32

Scalea T et al. J Am Coll Surg 2016.

KEY EQUIPMENT FOR EMERGENT REQUIREMENTS

TIME TO OR

Table 3. Critical Care Transfers to University of Maryland Medical Center's Acute Care Emergency Surgery and Cardiac Surgery Services: Pre- vs Post-Critical Care Resuscitation Unit

Variable	2011–2012 ACES+CS	2013–2014 ACES+CS	p Value
n	214	357	
Deaths, n (%)	31 (14.5)	45 (12.6)	0.60
Time from consult to arrival, min, median (IQR)	199 (138–368)	131 (77–254)	<0.001
Hospital LOS, d (excluding deaths), median (IQR)	9 (6–19)	10 (5–18)	1.00
Patients operated during hospitalization, n (%)	132 (61.7)	228 (63.9)	0.70
Deaths, n (%)	17 (12.9)	27 (11.8)	0.92
Time from consult to arrival, min, median (IQR)	202 (138–409)	120 (74–220)	<0.001
Time from arrival to incision, min, median (IQR)	1393 (462–5102)	779 (219–4,133)	<0.001
Hospital LOS, d (excluding deaths), median (IQR)	12 (7–25)	12 (7–22)	0.5
Procedure in operating room within 12 h of arrival, n (% of operations)	41 (31.1)	114 (50)	<0.001
Deaths, n (%)	7 (17.1)	12 (10.5)	0.4
Time from consult to arrival, min, median (IQR)	162 (113–225)	107 (68–169)	<0.001
Time from arrival to incision, min, median (IQR)	254 (164–447)	224 (156–408)	0.49
Hospital LOS, d (excluding deaths), median (IQR)	8 (6–20)	11 (7–19)	0.65

Scalea T et al. J Am Coll Surg 2016.

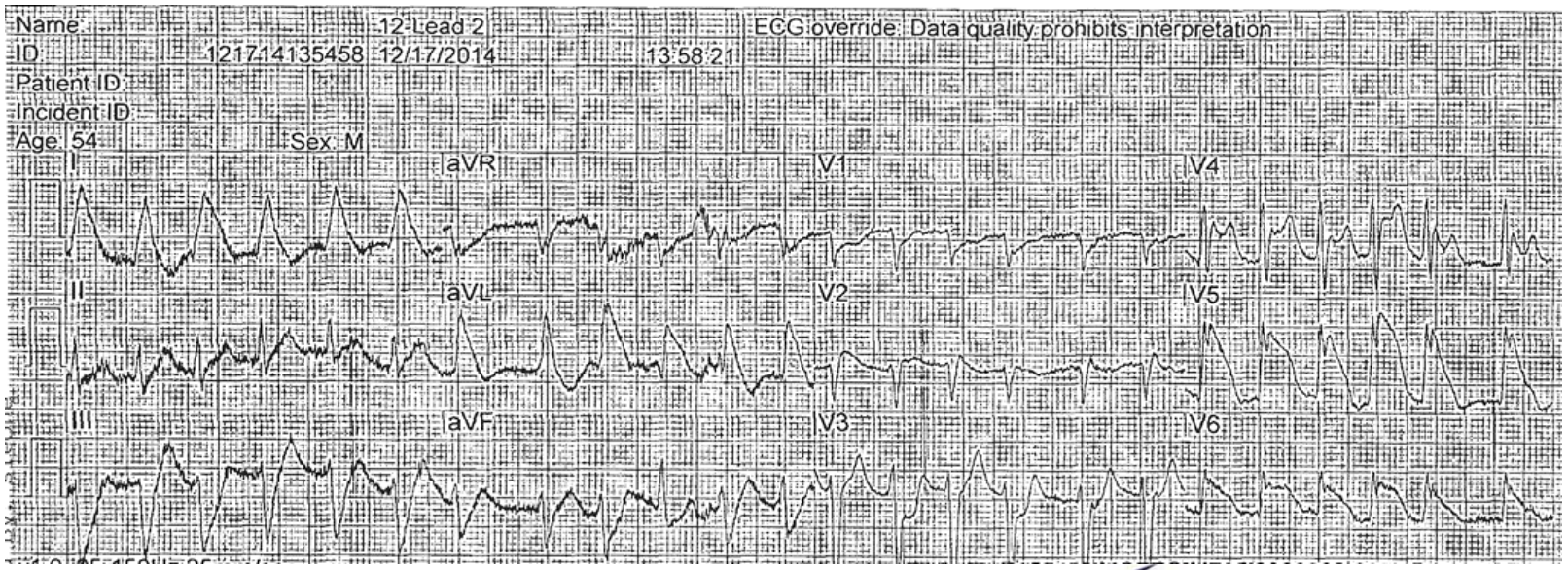
TIME TO NEURO ENDOVASCULAR INTERVENTION

DATA HERE

THE UNQUANTIFIABLE EXAMPLE: V-A ECMO REFERRAL

57 yo M calls 911, EMS arrives at ~1400 with sudden onset chest pain. EMS does EKG and diagnoses STEMI. ASA given.

Patient transported outside hosp @ 1431 with pre-hospital cath lab activation.



Slide courtesy of Dr. Daniel Haase

Shock Trauma Critical Care Ultrasonography

CASE CONTINUES

Cath lab course:

Eptifibatide, heparin, and norepinephrine drips started

Plavix 600mg administered

Left main coronary artery 99% occlusion

- *Wire passed, but unable to sufficiently aspirate, balloon or angiojet despite multiple attempts*
- *99% LAD, 70% ramus*

Pt more hypotensive (norepi @ 15mcg/min), so Intra-arterial Balloon Pump (IABP) inserted

Worsening respiratory status, so emergently intubated

Call to UMMC and CCRU @ 1620

Slide courtesy of Dr. Daniel Haase

Shock Trauma Critical Care Ultrasonography

TRANSFER, PRE-ARRIVAL AND EARLY EVAL

ExpressCare call taken @ 1620

Patient arrival to CCRU @ 1910 (delay at OSH)

Cardiac surgery, perfusion, and V-A ECMO cannulation/ circuit ready at bedside on patient arrival.

<u>Vital signs:</u>

HR 105, BP 75/40 (MAP 52)

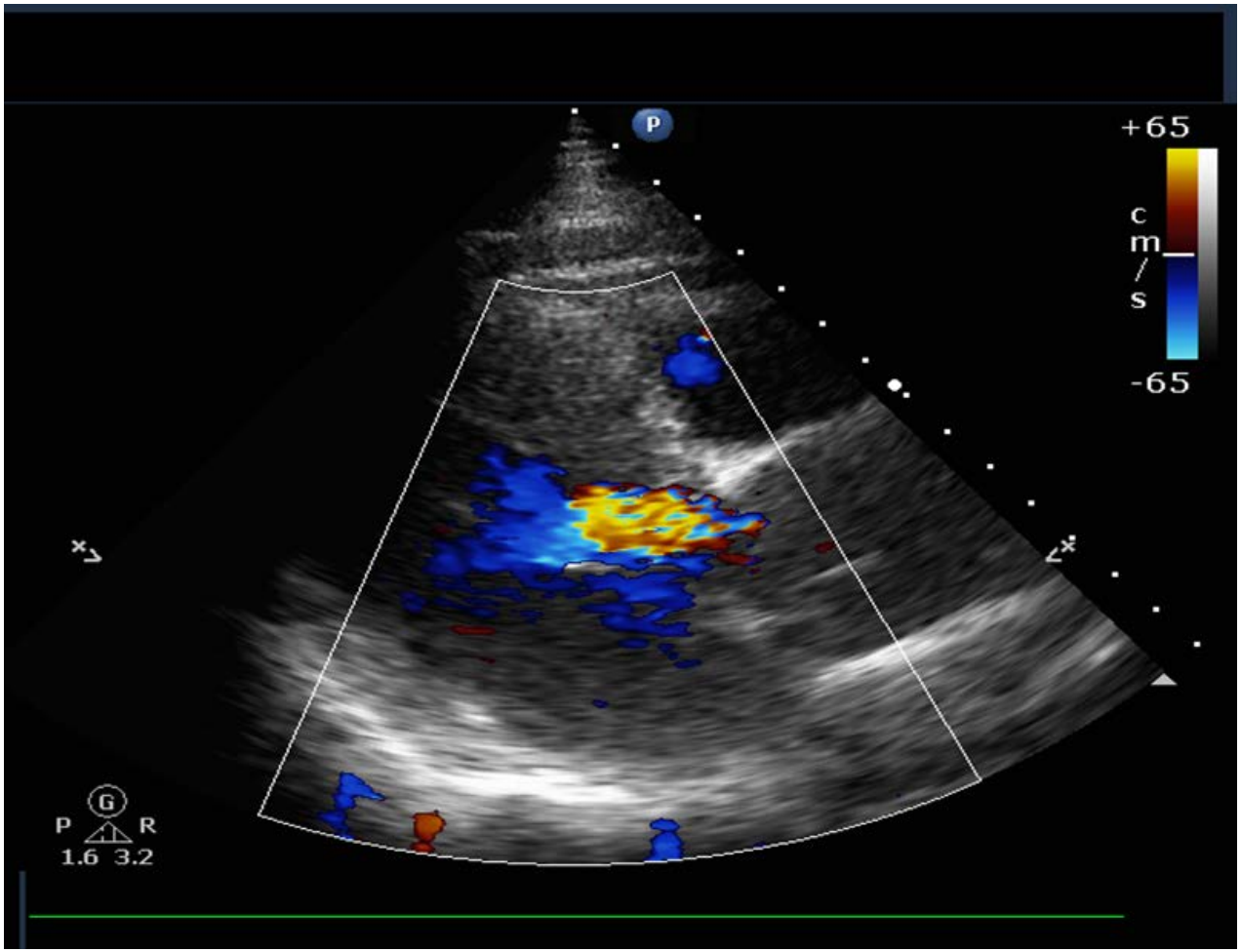
Norepi @ 15mcg/min (0.2 mcg/kg/min)

IABP 1:1 – “augmenting” to 56

Slide courtesy of Dr. Daniel Haase

Shock Trauma Critical Care Ultrasonography

IMMEDIATE LIMITED BEDSIDE ECHO



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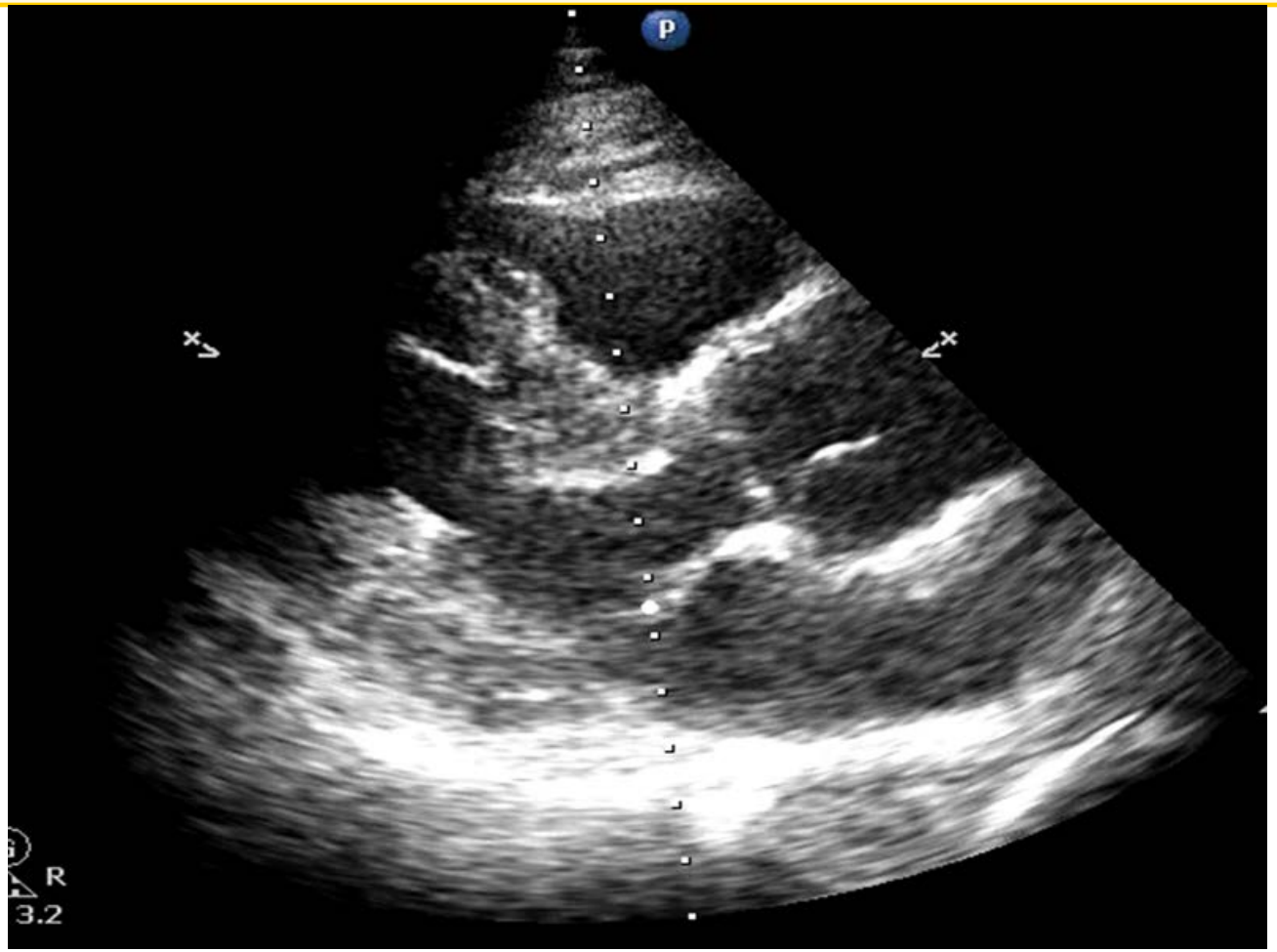
Shock Trauma Critical Care Ultrasonography

TYPE A AORTIC DISSECTION W/ ACUTE AORTIC INSUFF



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Shock Trauma Critical Care Ultrasonography

TYPE A DISSECTION WITH CARDIOGENIC SHOCK

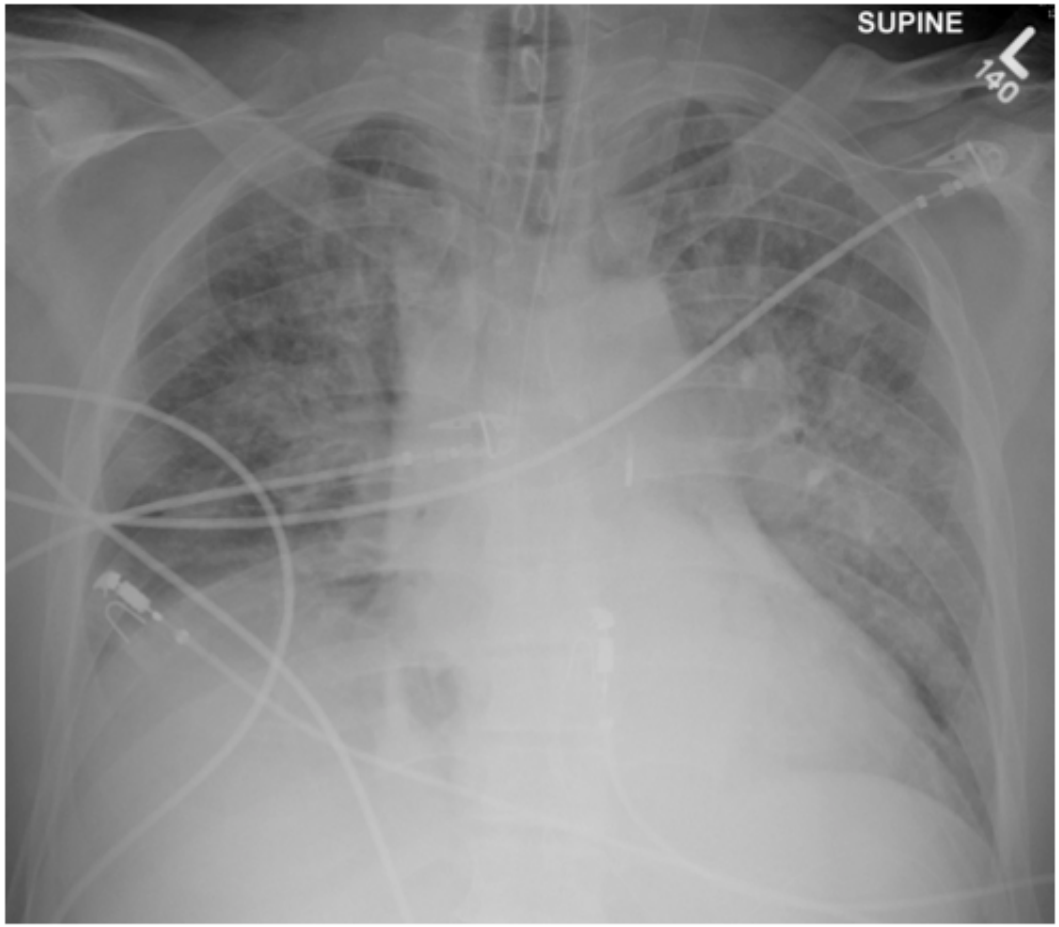
CCRU course:

Turn off IABP

Did not cannulate for VA ECMO (initially)

Stop anti-coagulation

Emergently to OR for dissection repair



Slide courtesy of Dr. Daniel Haase

Shock Trauma Critical Care Ultrasonography

ACTIVE MANAGEMENT OF PATIENT FLOW

CCRU attending works closely with UMMC/STC nursing coordinators (Patient Placement) and all ICU triage staff

As we near capacity, we immediately establish contingency plans to ensure there is always capacity/capability for true time-sensitive emergencies

- Bed availability is based on acuity of need, not number of beds

Established agreements w/ ICUs for prioritization of CCRU patients vs crashing floor pts vs ED patients

Speed bumps are dealt with quickly if determined to be system issue

CCRU, AN EXTRA HAND-OFF OPTIMAL COMM IS ESSENTIAL

1. Redundant communication with disposition unit
   - Attending CCRU to ICU (or other unit) attending/fellow
   - NP/PA to NP/PA verbal and written summary
   - Nurse to nurse

2. Consulting service is involved in CCRU

3. QA/QI Processes to ensure CCRU is optimizing communication

CCRU INVESTMENT

$2.75 M FTE budget (does not include physicians)

- 27 nurses
- 8 techs
- 6 NP/PAs
- Clerical staff

$0.75 M equip/etc

ROI complex

CCRU BECAME HOME FOR HIGH RESOURCE TIME-SENSITIVE CARE

Expanded CCRU role from outset for crashing pts in UMMC outside of ICUs

- Relationship with Rapid Response Teams

ED patients awaiting OR/ ICU bed and with time-sensitive need

- Does not address alll ED boarding challenges but allows resource-intensive pts to leave ED and get immediate care

Resuscitation, (optimal time-sensitive care) is about meeting requirements, not about location

- ED vs ICU less important than capability to meet time-sensitive requirements

Time-sensitive requirements must drive workflow/resource

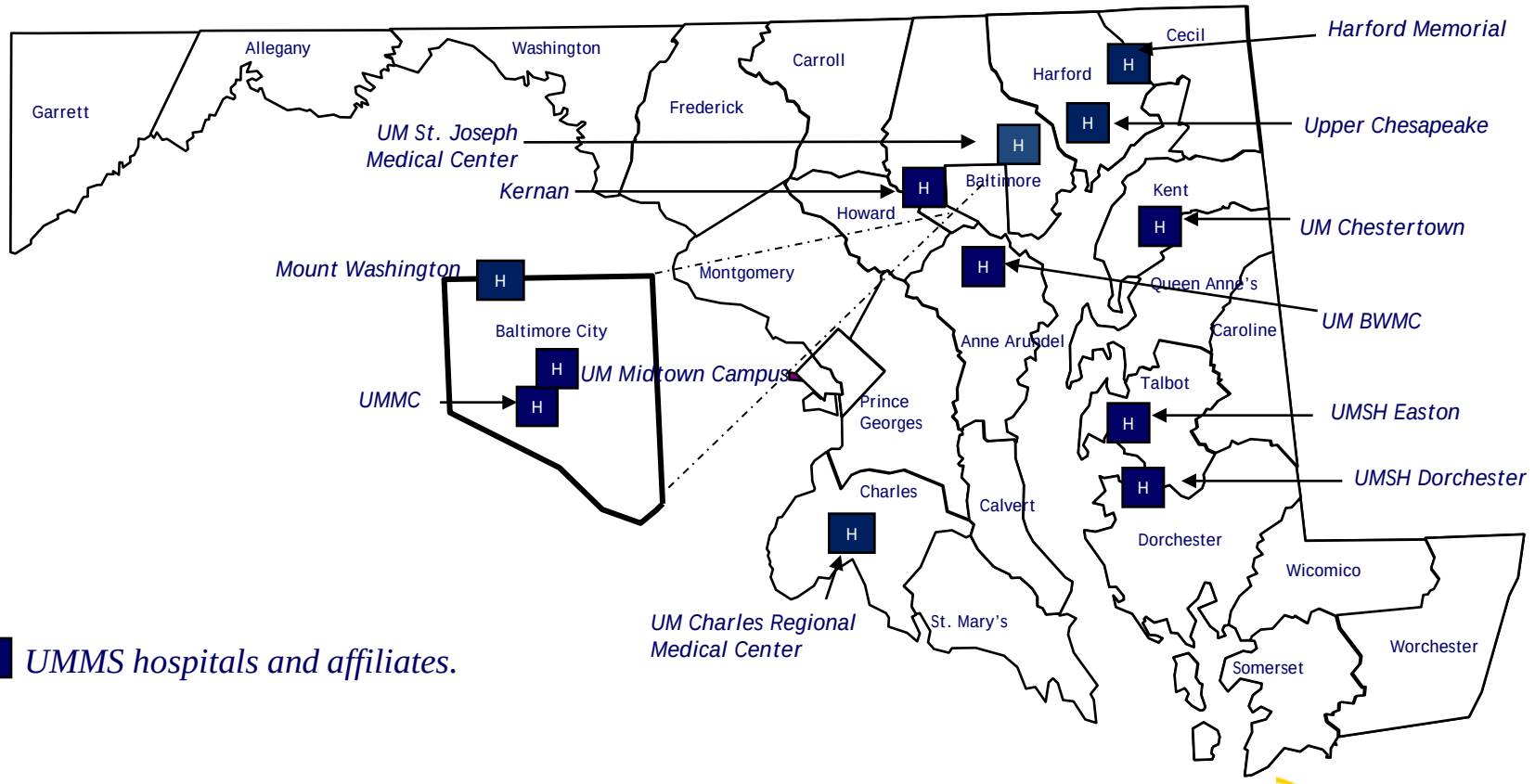
NEXT STEPS

Revise Maryland Express Care/ Patient Placement Center to Univ of MD Med System Access Center

Continue to improve patient flow and access through UMMC/UMMC

CCRU will re-locate near TRU to allow for flexible right-sizing of each unit/staff based on pt volume/acuity needs

THE NEAR FUTURE:REGIONALIZED NOT CENTRALIZED CRITICAL CARE



H *UMMS hospitals and affiliates.*

R Adams Cowley Shock Trauma Center
University of Maryland

SHOCK TRAUMA'S MISSION

"To serve as a multidisciplinary clinical, educational and research institution dedicated to world class standards in the prevention and management of critical injury and illness and its consequences."

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