Emergent Trauma Laparotomy

Transforming Care for Optimal Outcomes

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Disclosures

- None

Objectives

1. What is emergent trauma laparotomy and why is it important?

2. Outcomes based research on emergent trauma laparotomy

3. Future questions for emergent trauma laparotomy

Excluded

Not an exhaustive list of all improvements or best practices in trauma laparotomy

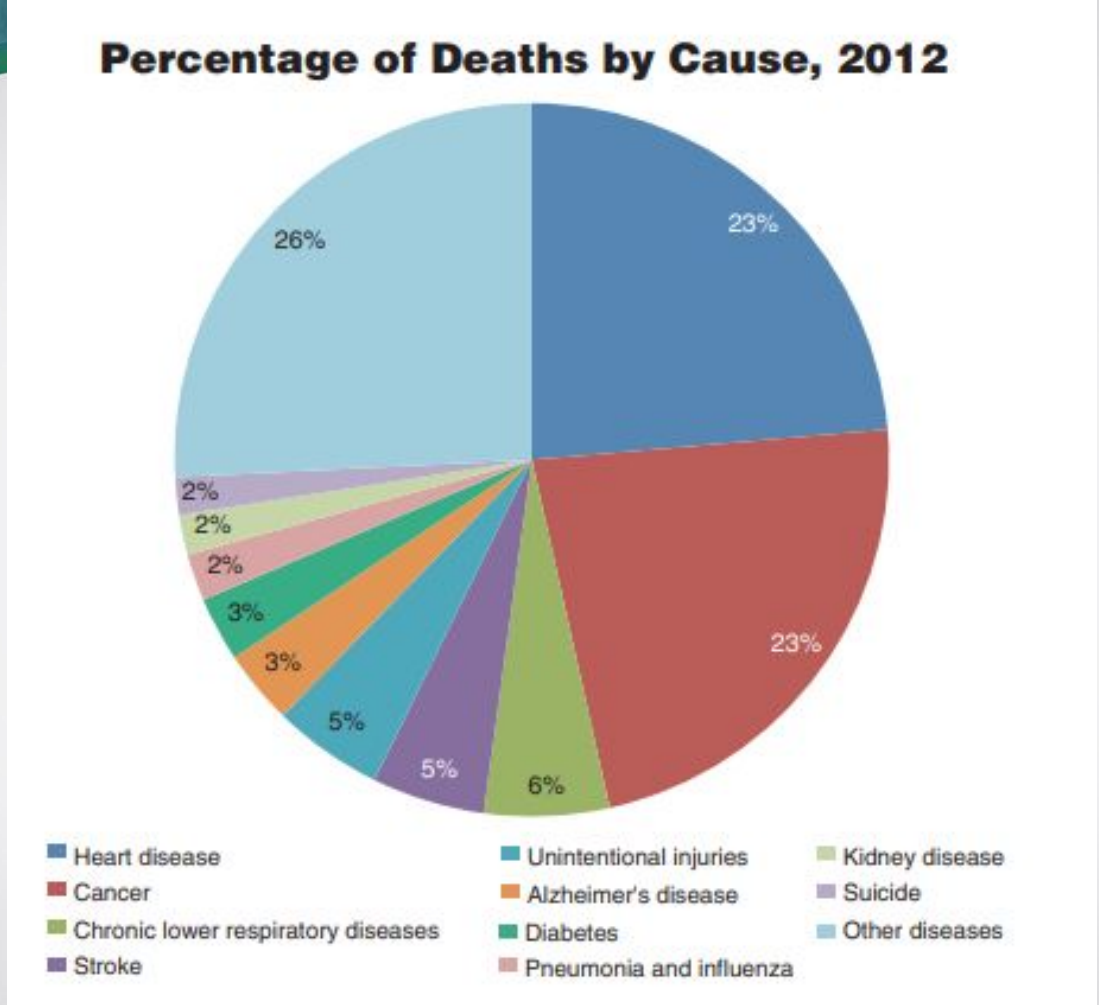
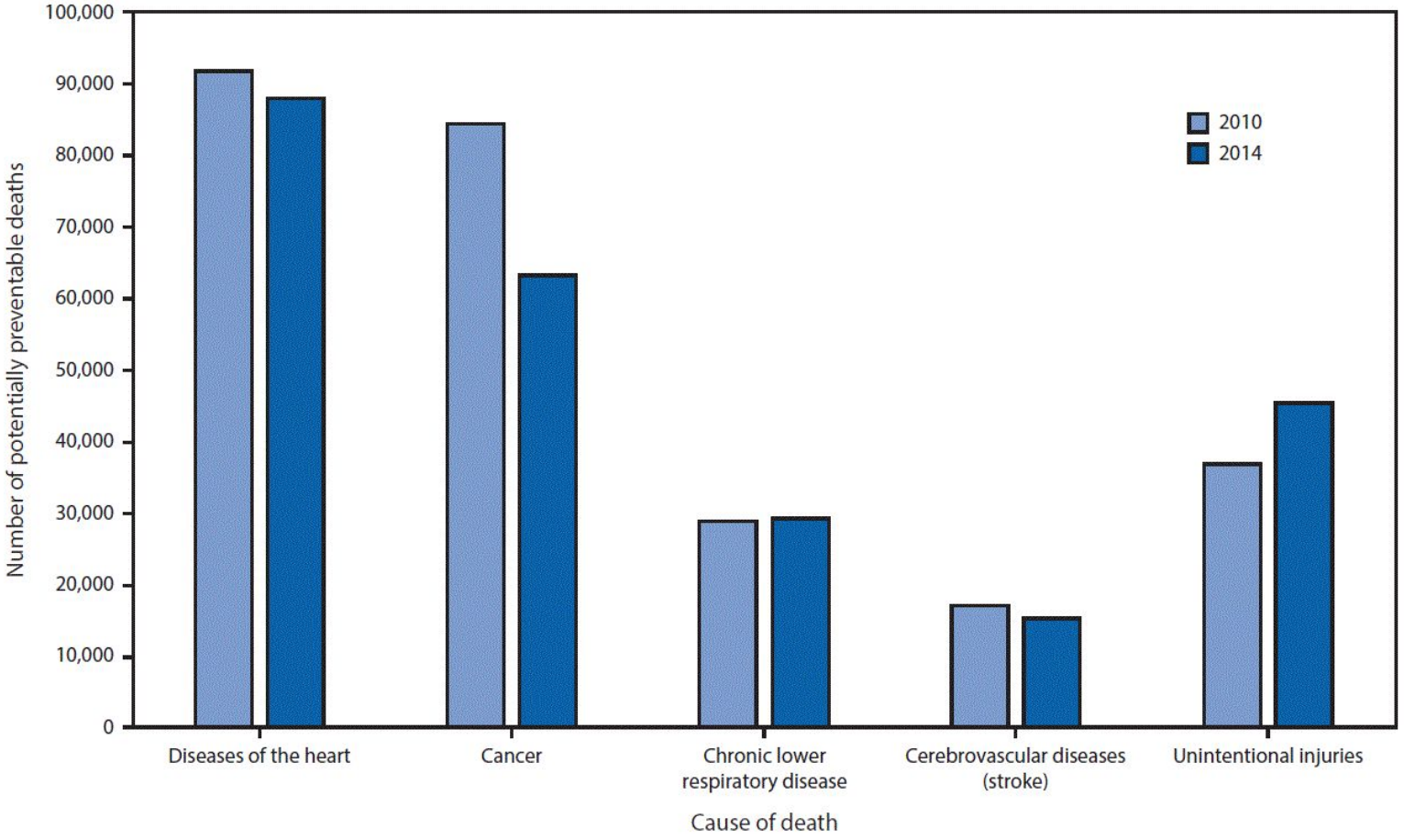


FIGURE. Number of potentially preventable deaths among the five leading causes of death, for persons aged <80 years — United States, 2010 and 2014



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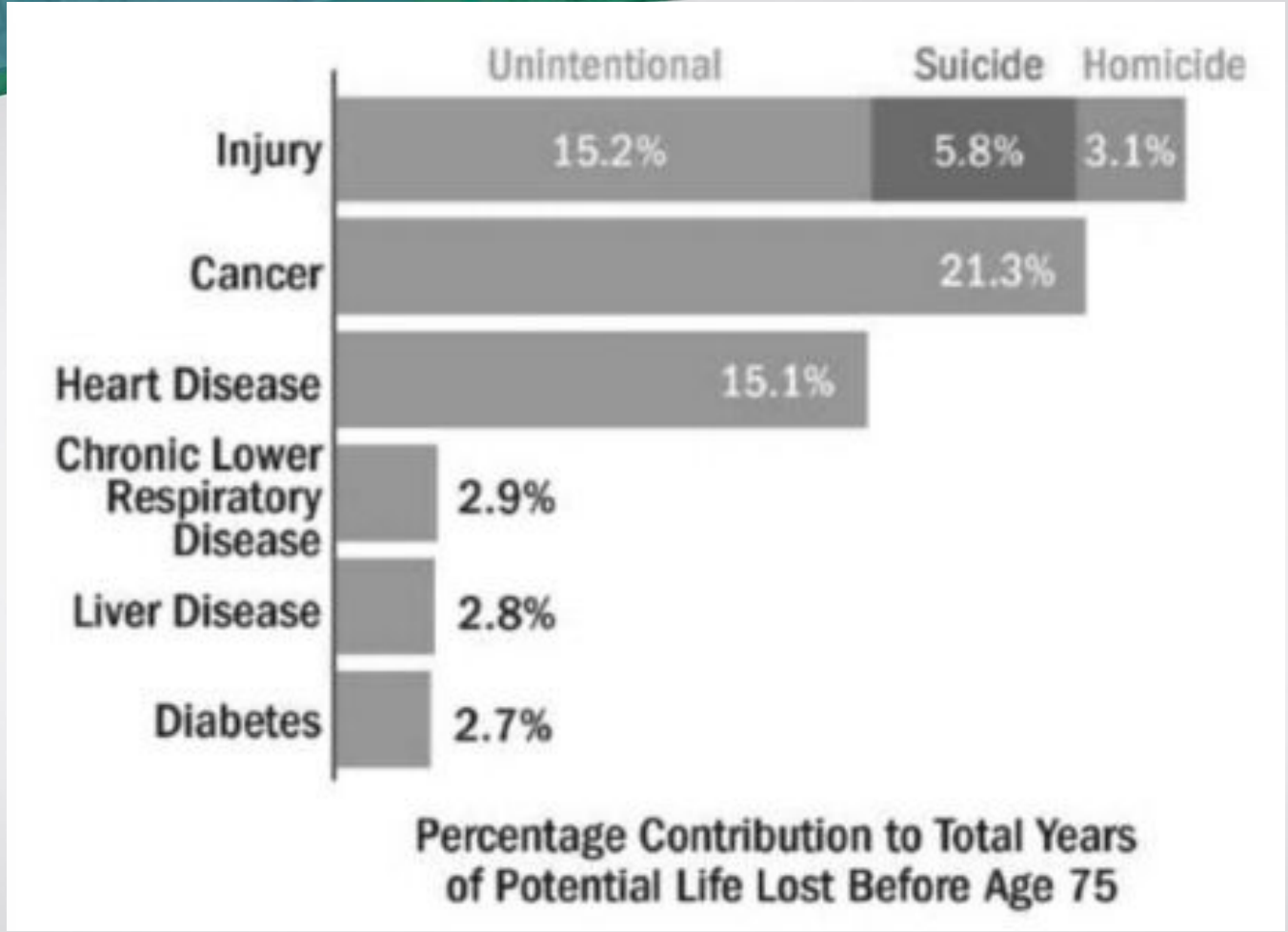

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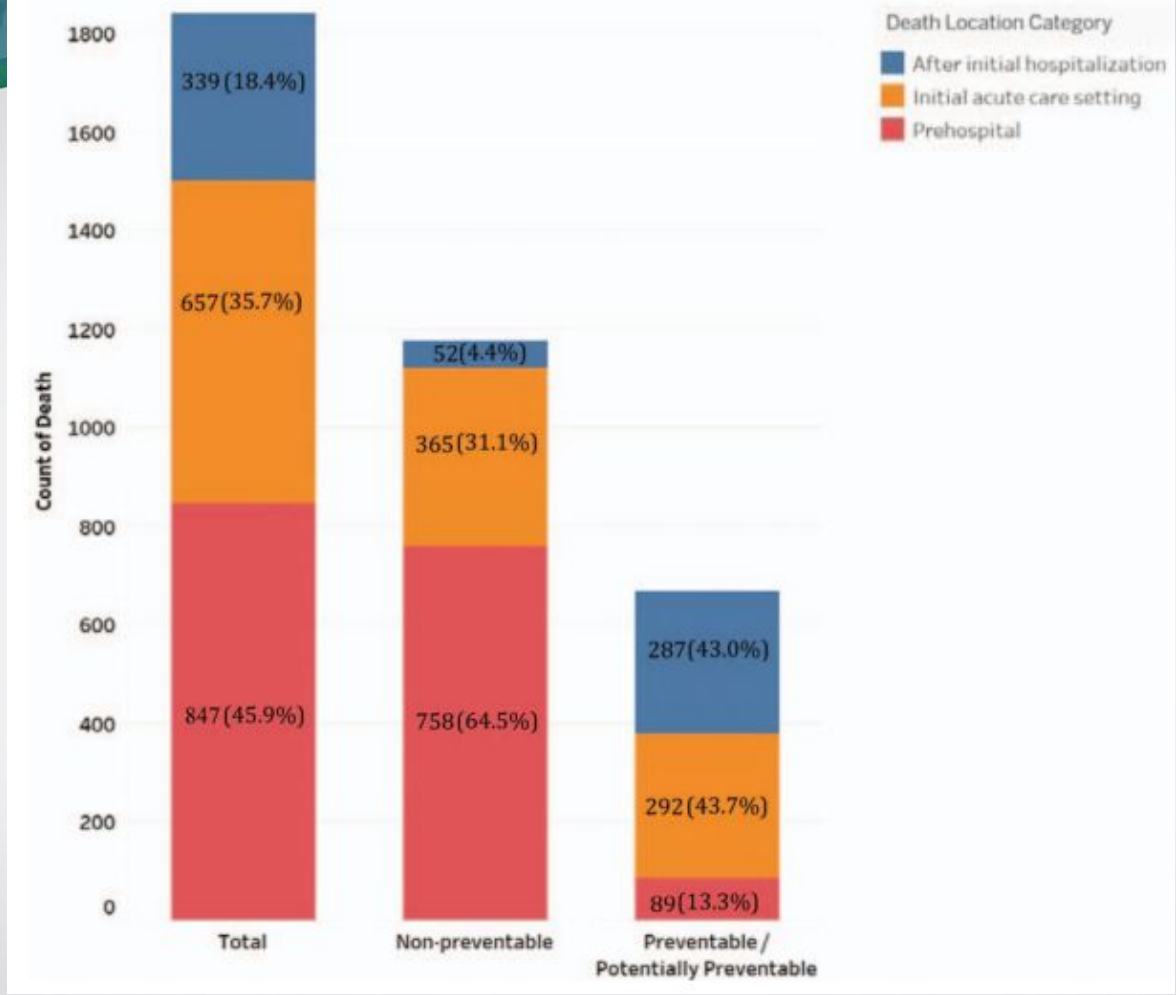

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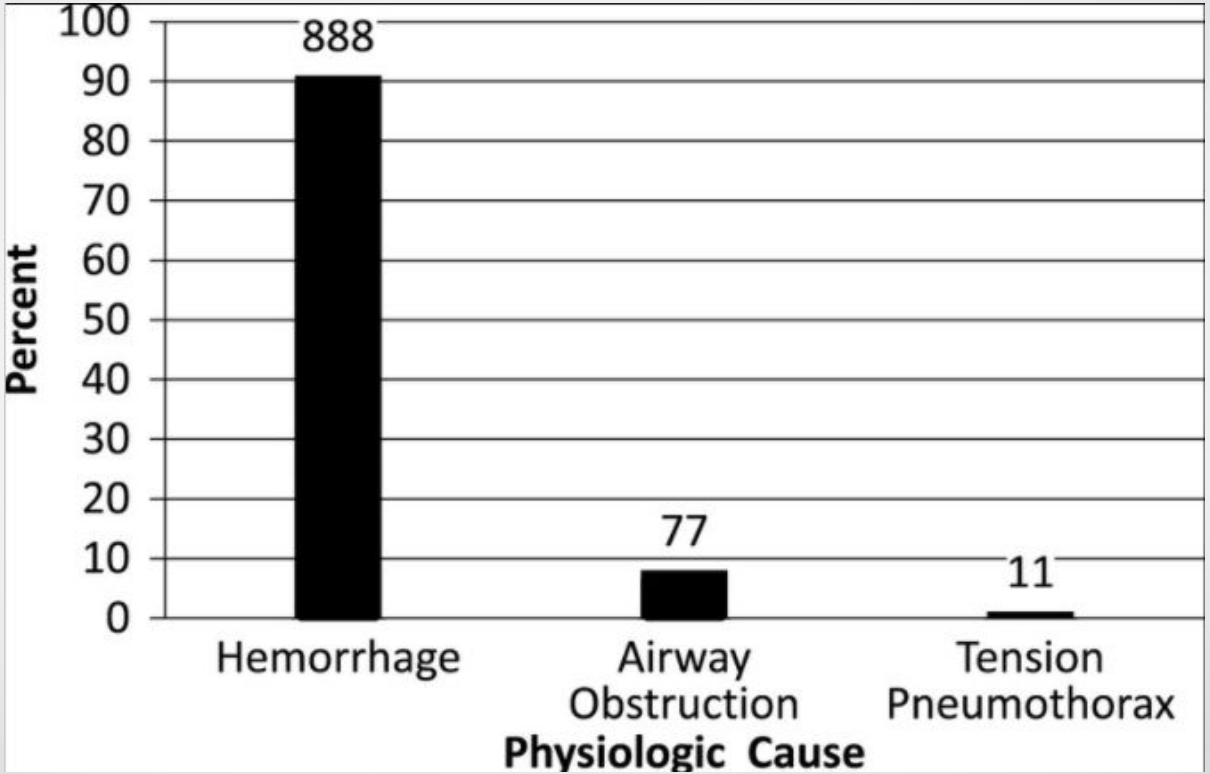
Preventable Death



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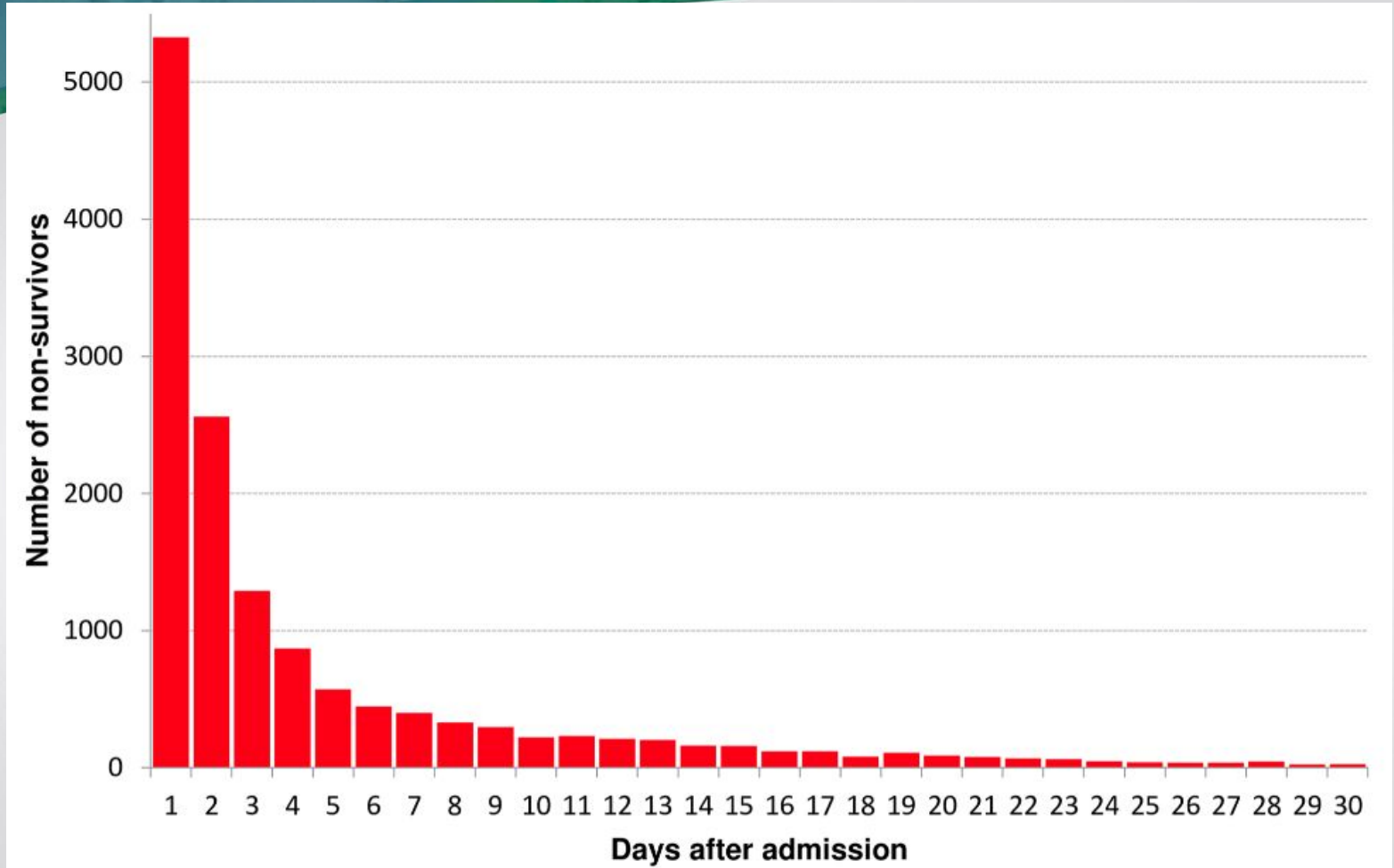

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Time to Death with Hemorrhage

TABLE 2. Outcomes of Patients Requiring Emergent OR/IR (N = 468)

Variables	Group 1 (n = 102)	Group 2 (n = 102)	Group 3 (n = 104)	Group 4 (n = 100)	Group 5 (n = 60)	*p**
Transfusions during active resuscitation						<0.01
RBC (units)	5 (4, 8)	7 (4, 11)	8 (5, 14)	13 (8, 24)	20 (11, 37)	
Plasma (units)	2 (1, 3)	3 (2, 6)	5 (2, 10)	8 (4, 15)	14 (6, 20)	
Platelets (units)	1 (0, 1)	1 (0, 2)	1 (1, 2)	2 (1, 3)	3 (1, 4)	
Mortality at 6 h (n, %)	0 (0%)	0 (0%)	1 (1%)	0 (0%)	55 (92%)	1.00
Mortality at 24 h (n, %)	1 (1%)	2 (2%)	2 (2%)	1 (%)	59 (98%)	1.00
Mortality at 30 d (n, %)	8 (8%)	8 (8%)	8 (8%)	15 (15%)	60 (100%)	0.25
Time to death (d)	3.6 (1.3, 6.3)	2.8 (0.8, 11.9)	7.1 (1.5, 18.5)	8.8 (2.5, 11.2)	0.09 (0.05, 0.15)	0.74

- Median time of death = 2.2 hours

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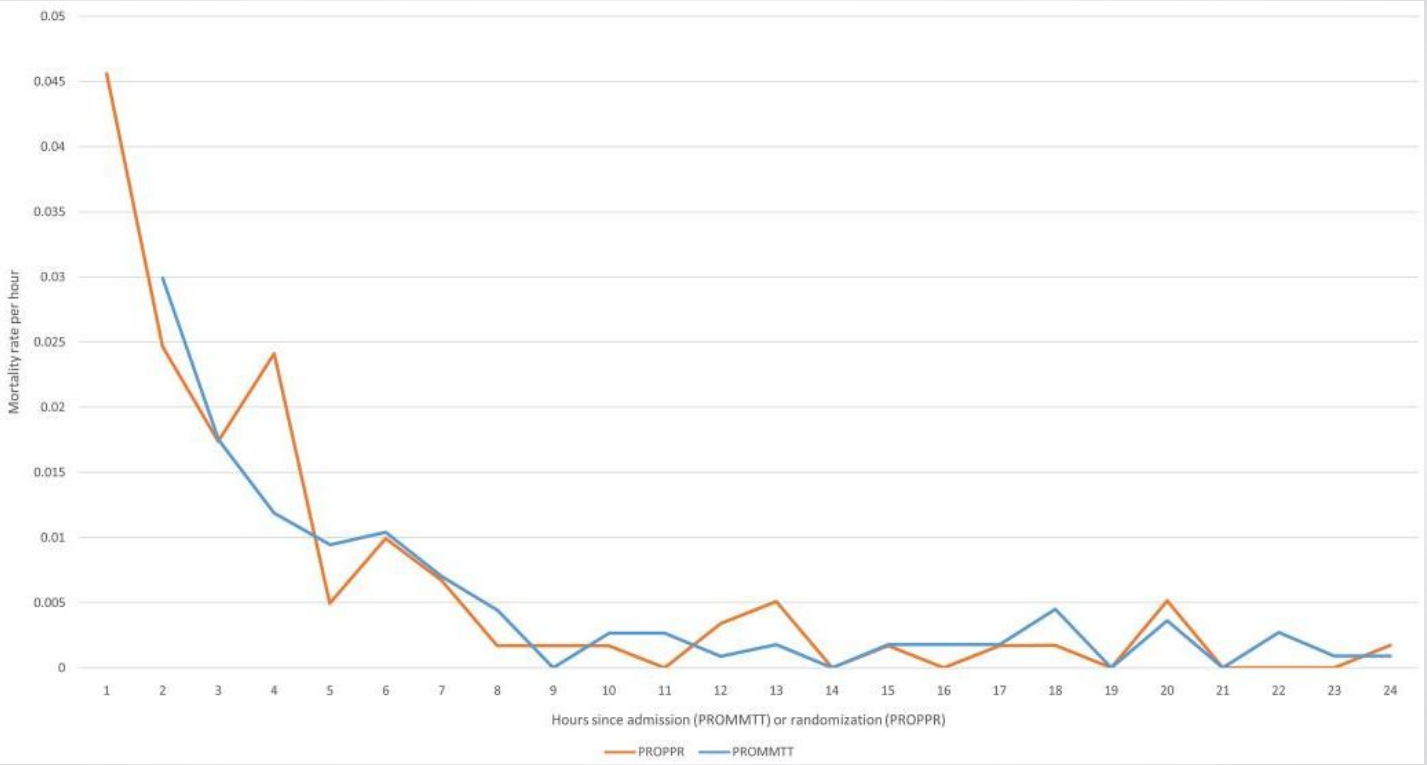
Time to Death with Hemorrhage



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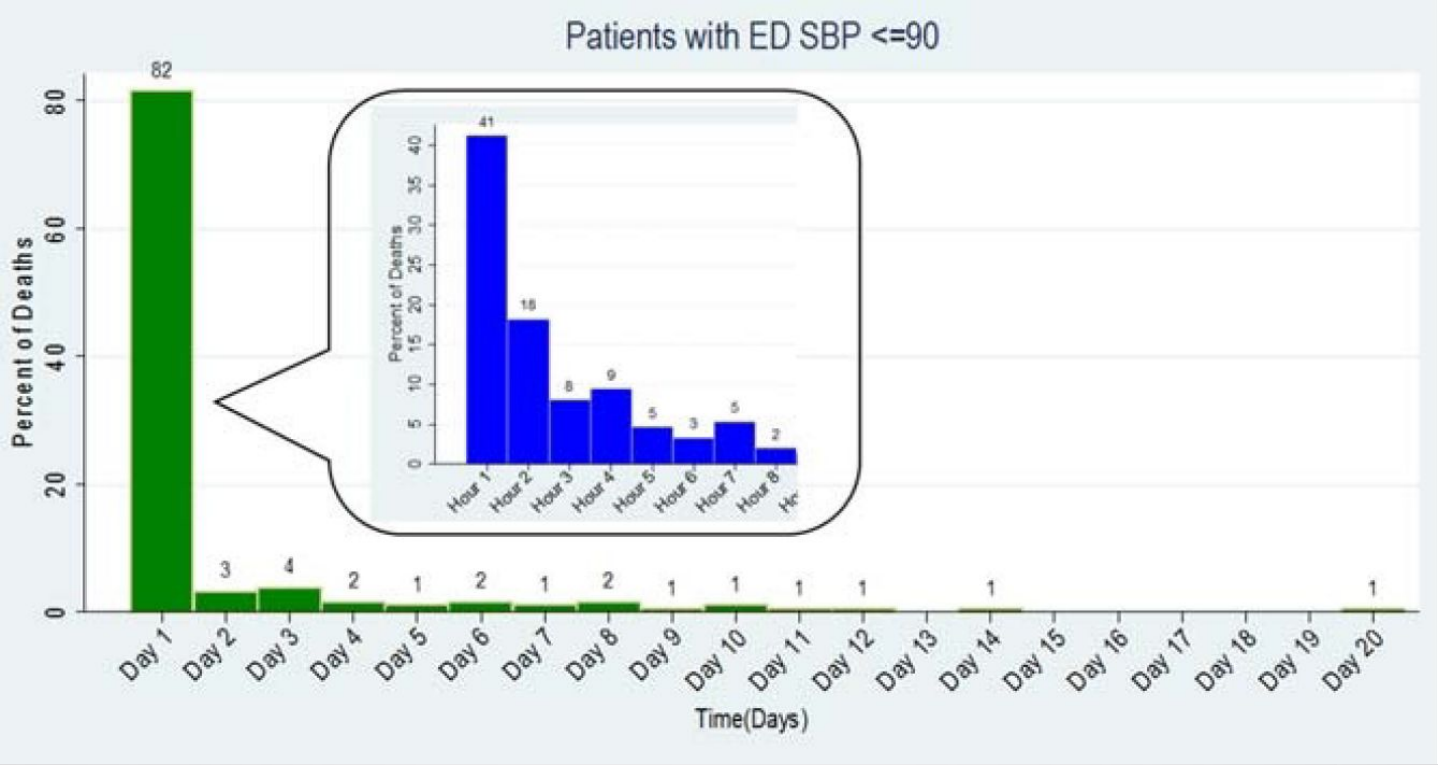
Time to Death in ETL



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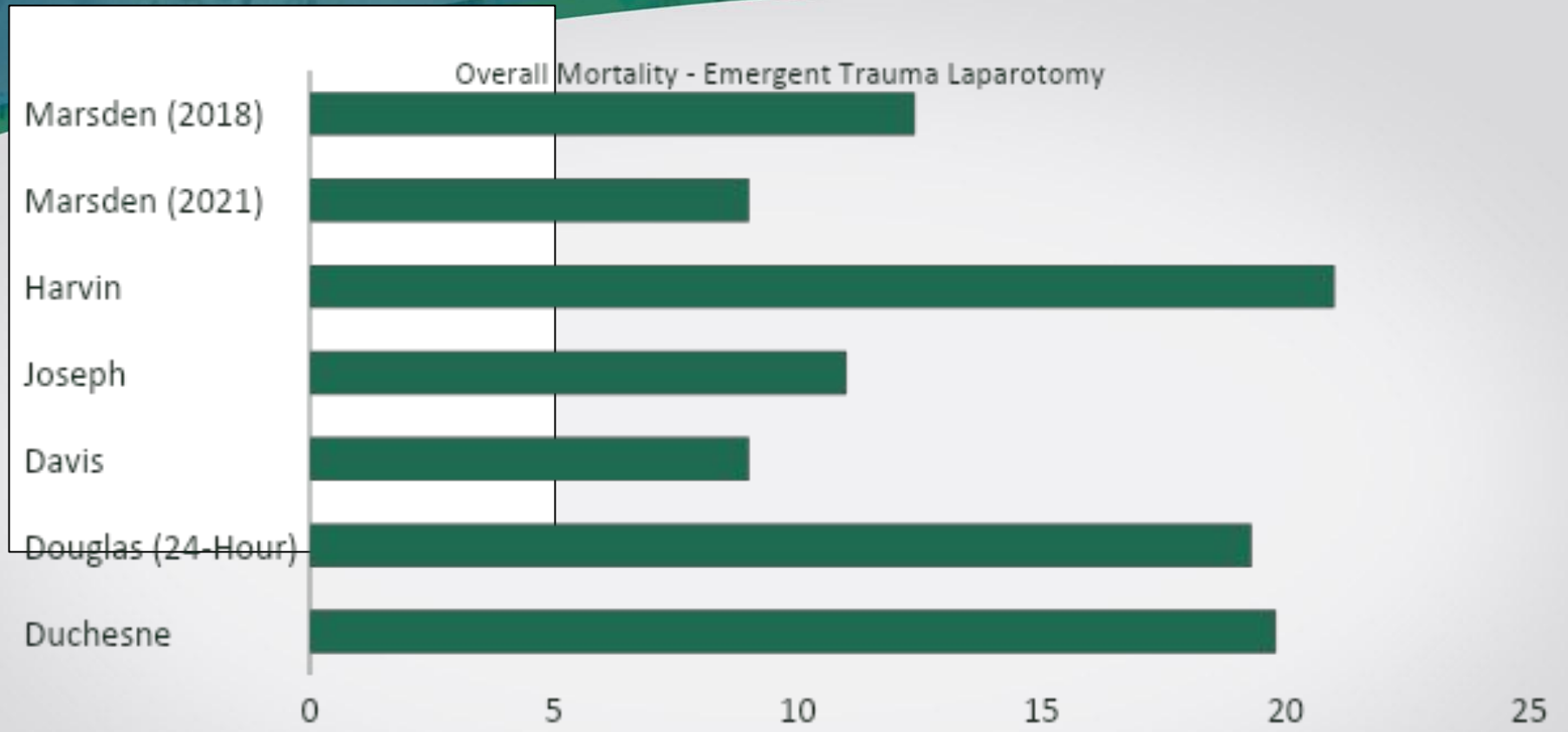

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2. Marsden M, Vuilliamy P, Carden R, et al. Trauma laparotomy in the UK: A prospective national service evaluation. J Am Coll Surg. 2021 Sep; 233(3):383-394.e1
3. Harvin JA, Maxim T, Inaba K, et al. Mortality following emergent trauma laparotomy: a multicenter, retrospective study. J Trauma Acute Care Surg. 2017 Sep; 83(3):464-468.
4. Joseph B, Azim A, Zangbar B, et al. Improving mortality in trauma laparotomy through the evolution of damage control resuscitation: Analysis of 1,030 consecutive trauma laparotomies. 2017 Feb; 82(2):328-333.
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7. Douglas M, Hammad A, Nelson A, et al. After 9,000 laparotomies for blunt trauma, resuscitation if becoming more balanced and time to intervention shorter: How low can we go? In: Annual meeting of the American Association for the Surgery of Trauma. Sept 29 – Oct 2, 2021; Atlanta, GA.

Emergent Trauma Laparotomy

Associated with high rates of mortality

Mortality primarily due to hemorrhage

Main source to limit preventable death

Emergent Trauma Laparotomy

Signature operation of the trauma surgeon

Emergent Trauma Laparotomy

Names

- Exploratory Laparotomy
- Exploratory Celiotomy
- Trauma Laparotomy
- Ex lap
- Laparotomy
- Celiotomy
- Abdominal Exploration

Emergent Trauma Laparotomy

Urgent exploration of the abdominal cavity to control life threating injuries

Goals

- Surgical hemorrhage control
- Control abdominal contamination
- Restore intestinal continuity

Included

- Hepatic
- Splenic
- Renal
- Pancreas

- Esophagus

Historical Management

- Complex repairs
- Long operative times
- Massive volume resuscitation

Objectives

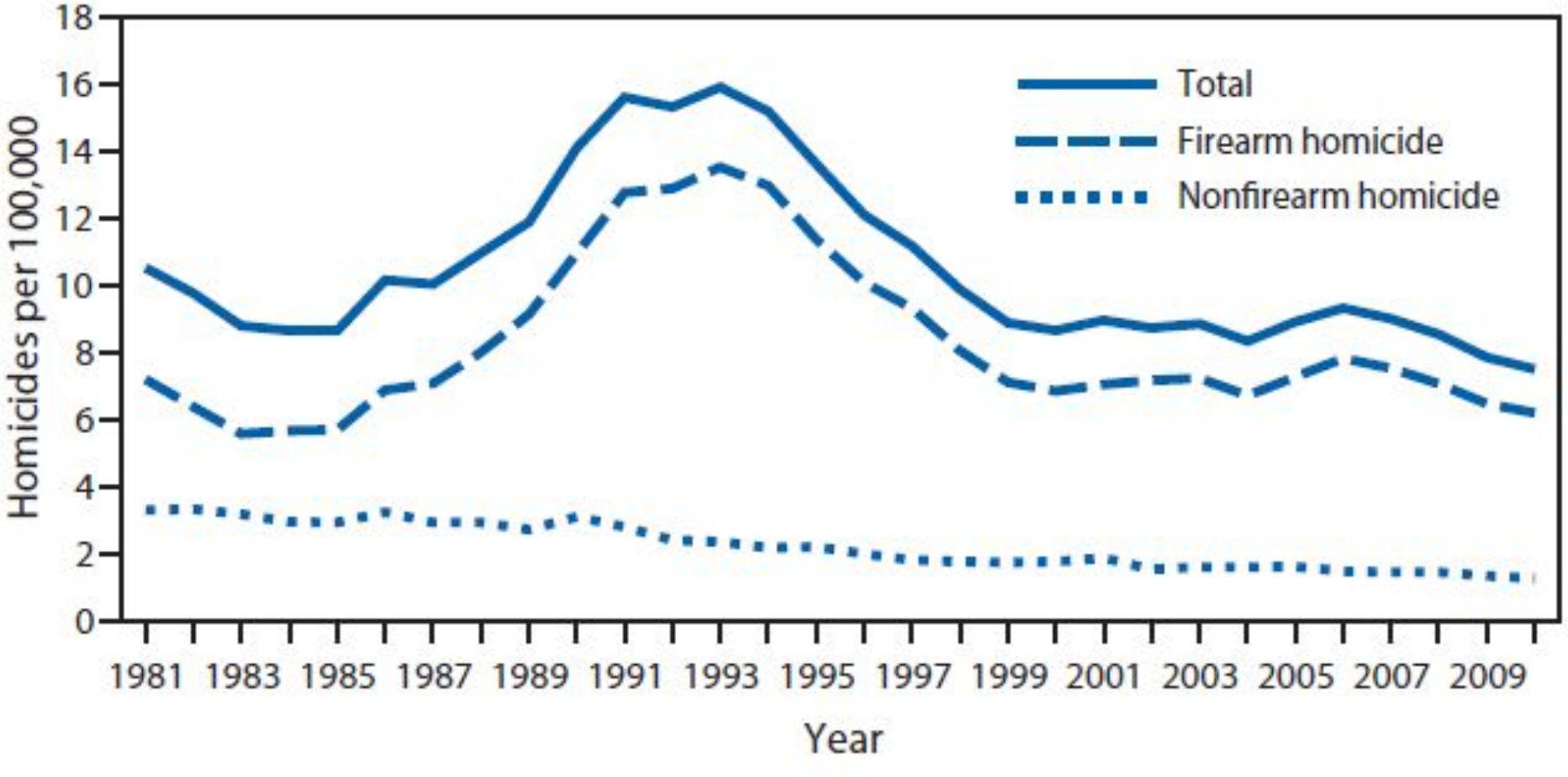
1. *What is emergent trauma laparotomy and why is it important?*
2. Outcomes based research on emergent trauma laparotomy
3. Challenges and future questions for emergent trauma laparotomy

Examples

Damage Control Laparotomy

Changing resuscitation practice

Variation among individual surgeons



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Management of the Major Coagulopathy with Onset during Laparotomy

H. HARLAN STONE, M.D., PRISCILLA R. STROM, M.D., RICHARD J. MULLINS, M.D.

- Conventional: 7% (1/14)
- Abbreviated: 65% (11/17)

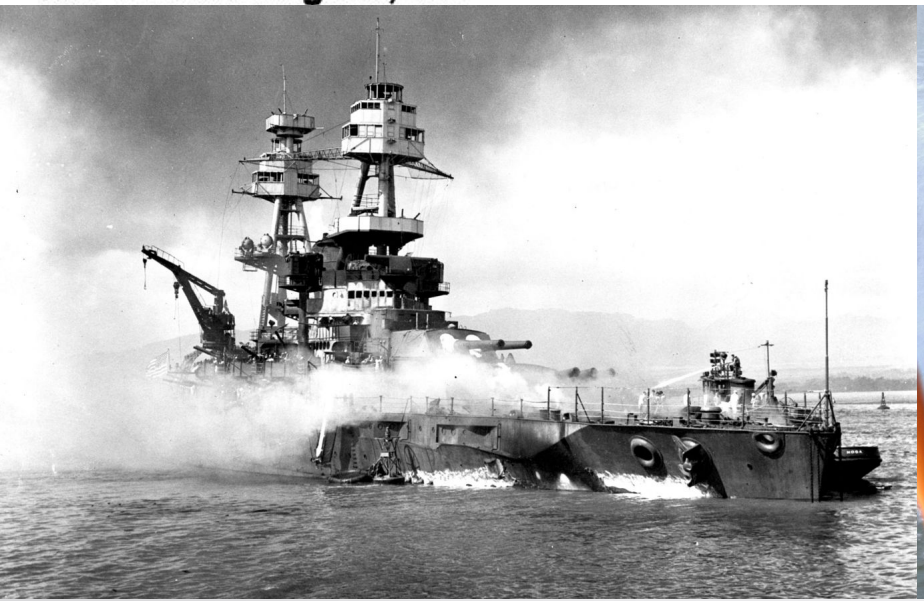
1. Stone HH, Strom PR, Mullins RJ. Management of the major coagulopathy with onset during laparotomy. Ann Surg. 1983; 197: 532-535. 1983

Damage Control Laparotomy

- Described by Pringle in 1908
- Further modified by Halsted in 1913
- Fell out of favor by the end of World War II

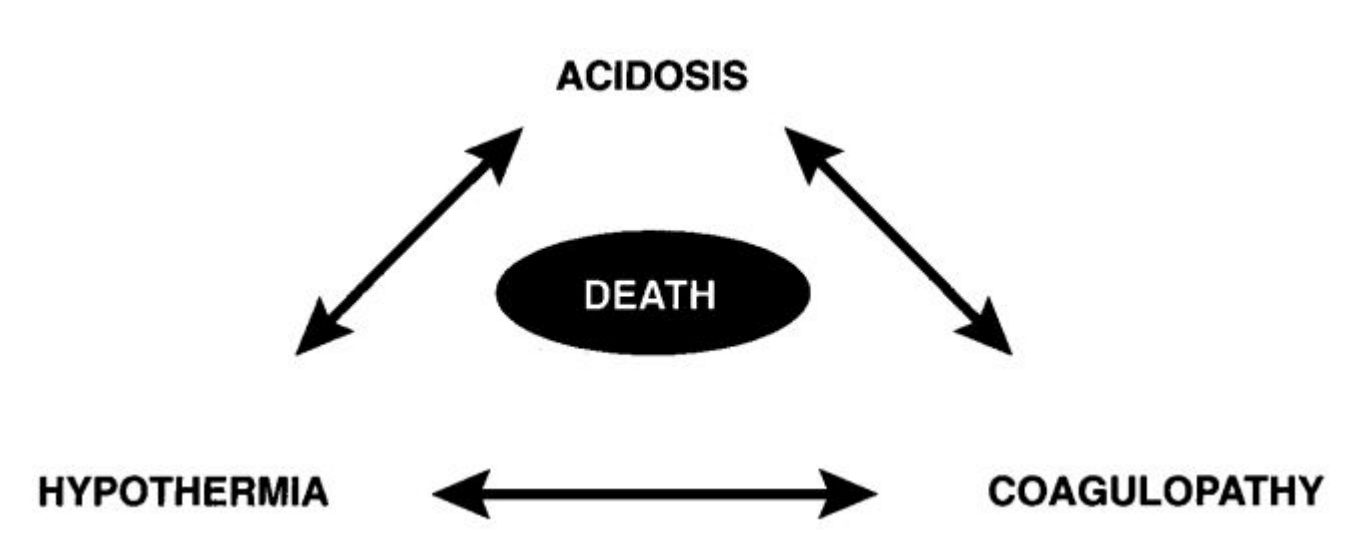
‘DAMAGE CONTROL’: AN APPROACH FOR IMPROVED SURVIVAL IN EXSANGUINATING PENETRATING ABDOMINAL INJURY

Michael F. Rotondo, MD, C. William Schwab, MD, FACS, Michael D. McGonigal, MD, FACS, Gordon R. Phillips, III, MD, Todd M. Fruchterman, BA, Donald R. Kauder, MD, FACS, Barbara A. Latenser, MD, and Peter A. Angood, MD



1. Rotondo MF, Schwab CW, McGonigal MD, et al. ‘Damage control’: an approach for improved survival in exsanguinating penetrating abdominal injury. **J Trauma.** 1993 Sep; 35(3): 375-82.

Damage Control



1. Rotondo MF and Zonies DH. The damage control sequence and underlying logic. **Surg Clin North Am.** 1997 Aug; 77(4): 761-77.

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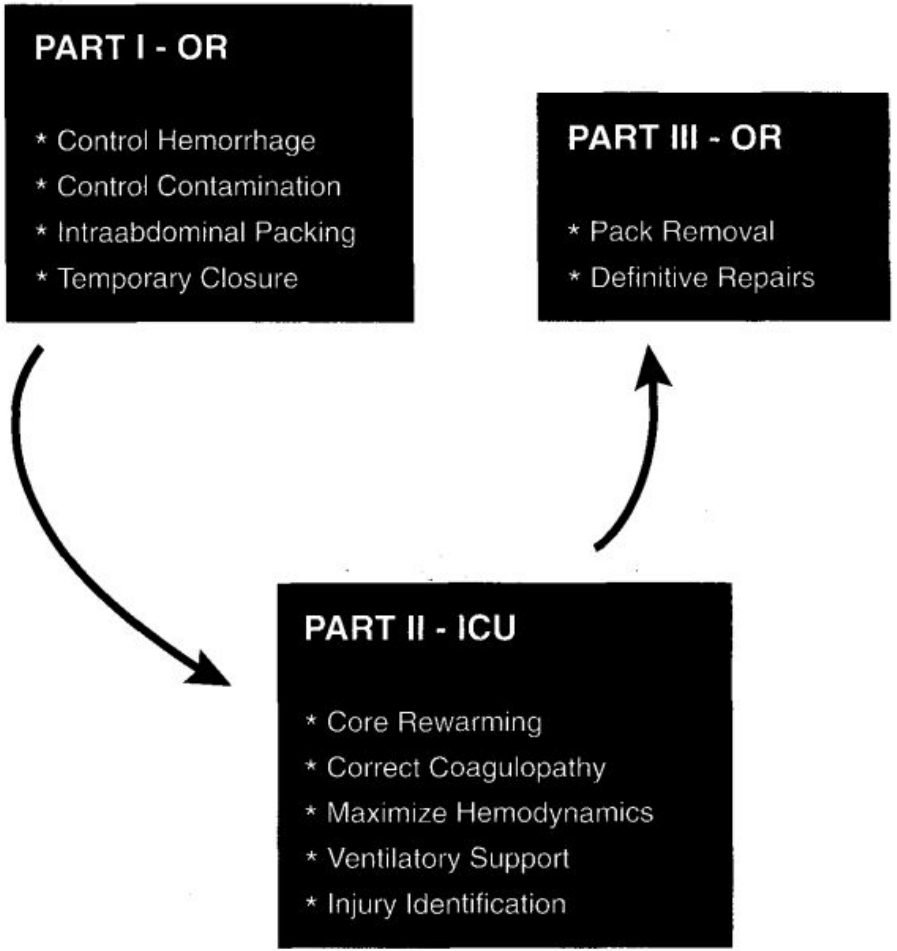


1. Rotondo MF and Zonies DH. The damage control sequence and underlying logic. **Surg Clin North Am.** 1997 Aug; 77(4): 761-77.

Evolution in Damage Control for Exsanguinating Penetrating Abdominal Injury

Jon W. Johnson, MD, Vicente H. Gracias, MD, C. William Schwab, MD, FACS, Patrick M. Reilly, MD, FACS, Donald R. Kauder, MD, FACS, Michael B. Shapiro, MD, FACS, G. Paul Dabrowski, MD, FACS, and Michael F. Rotondo, MD, FACS

Table 6 Patient Survival

Parameter	Current Period (n = 21)	Historical Period (n = 24)	*p* Value
Survival (%)	90	58	0.02
ISS	30.4 ± 15.3	30.6 ± 9.6	0.18
PATI	33.1 ± 12.8	37.0 ± 13.9	0.335
OR—lowest temp	34.9 ± 1.4	32.9 ± 1.4	<0.001
ICU pH—on arrival	7.37 ± 0.11	7.37 ± 0.12	1.00
ICU PT—on arrival	15.2 ± 1.5	19.6 ± 9.2	0.05
ICU PTT—on arrival	36.8 ± 10.0	70.4 ± 39.5	0.001

1. Johnson JW, Gracias VH, Schwab CW, et al. Evolution in damage control for exsanguinating penetrating abdominal injury. J Trauma 2001; 51: 261-271.

Damage Control

Year	Author	Number	Mortality (%)	Morbidity (%)
1976	Lucas	3	0/3 (0)	— (—)
1979	Calne	4	0/4 (0)	— (—)
1981	Feliciano	10	1/10 (10)	6/9 (67)
1982	Svoboda	12	2/12 (17)	— (—)
1984	Carmona	17	2/17 (12)	5/15 (33)
1986	Baracco	36	6/36 (17)	4/36 (11)
1986	Ivatury	14	8/14 (57)	5/6 (83)
1986	Feliciano	66	38/66 (58)	9/49 (19)
1988	Cogbill	52	31/52 (60)	3/21 (14)
1990	Saifi	9	2/9 (22)	6/9 (67)
1990	Beal	49	19/49 (39)	7/30 (23)
1990	Aprahamian	20	4/20 (20)	9/16 (56)
1990	Cue	35	17/35 (49)	19/21 (90)
1992	Krige	22	6/22 (27)	12/16 (75)
1992	Sharp	39	17/39 (44)	6/22 (27)
1993	Morris	107	64/107 (60)	22/43 (51)
Totals		**495**	**217/495 (44)**	**113/293 (39)**

1. Rotondo MF and Zonies DH. The damage control sequence and underlying logic. **Surg Clin North Am.** 1997 Aug; 77(4): 761-77.

Damage Control

Year	Author	Number	Mortality (%)	Morbidity (%)
1983	Stone	17	6/17 (35)	11/11 (100)
1992	Burch	200	134/200 (67)	38/86 (44)
1992	Shen	6	3/6 (50)	— (—)
1992	Talbert	11	4/11 (36)	3/7 (43)
1993	Carillo	14	2/14 (14)	9/12 (75)
1993	Rotondo	24	10/24 (42)	5/14 (36)
1994	Hirshberg	124	72/124 (58)	— (—)
1996	Garrison	70	47/70 (67)	6/38 (16)
Totals		**466**	**278/466 (60)**	**72/168 (43)**

1. Rotondo MF and Zonies DH. The damage control sequence and underlying logic. **Surg Clin North Am.** 1997 Aug; 77(4): 761-77.

Damage Control

Complication	Total No. (n = 185)	Frequency (%) (n = 461)
Abdominal abscess/collection	109	24
Wound infection/dehiscence	38	8.2
Bile leak	17	3.7
Intestinal fistula	11	2.4
Intestinal necrosis	7	1.5
Intestinal obstruction	4	0.8
Pancreatic fistula	2	0.4
Renal leak	2	0.4
Cholecystitis	1	0.2
Gastritis	1	0.2
Pancreatic pseudocyst	1	0.2
Total	**193***	**40**

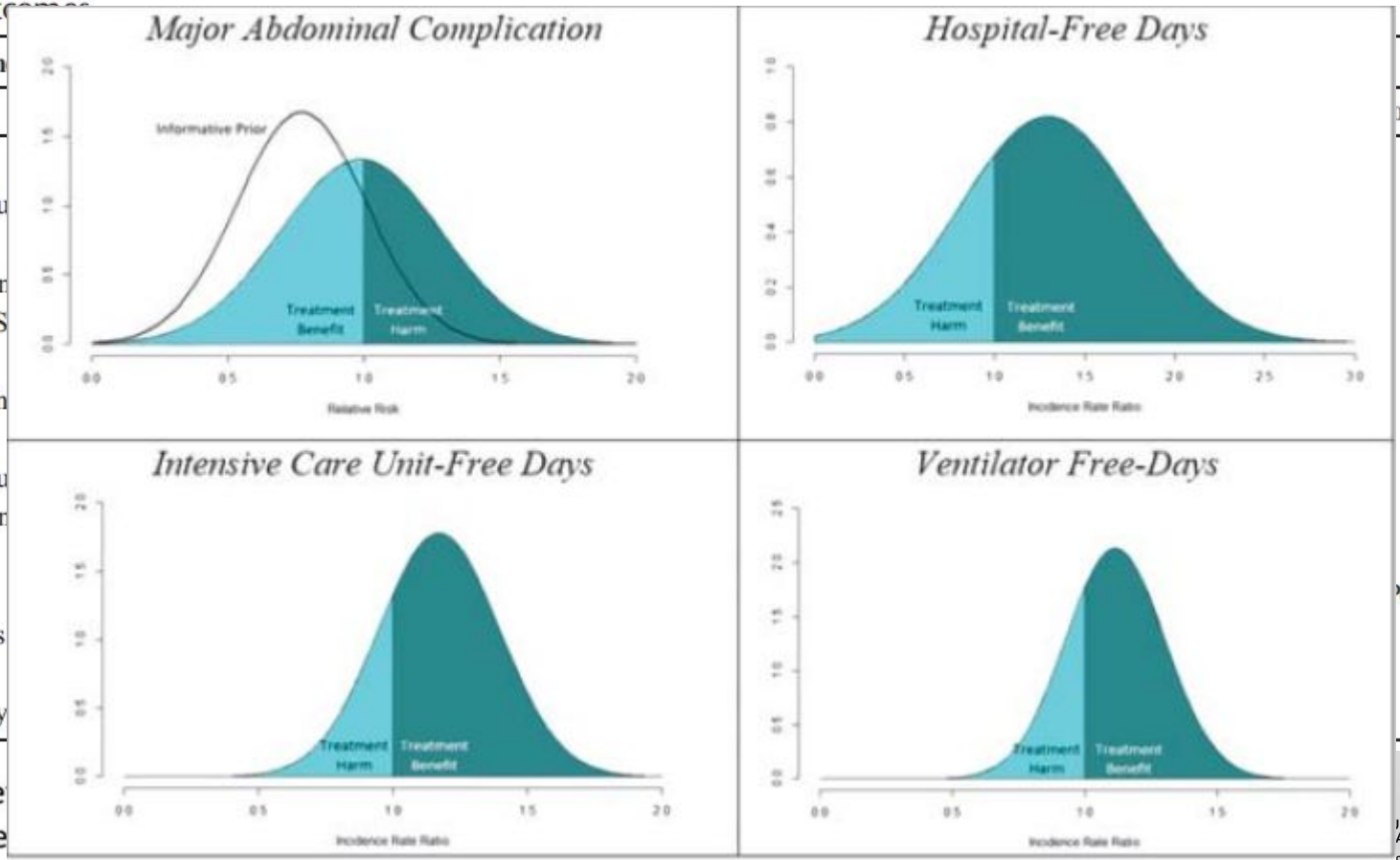
1. Rotondo MF and Zonies DH. The damage control sequence and underlying logic. **Surg Clin North Am.** 1997 Aug; 77(4): 761-77.

Effect of damage control laparotomy on major abdominal

TABLE 4. Outc

Primary Outcom	osterior Probability
MACs	56%
Suture line failu	
EA/EC fistula	
Fascial dehiscen	
Organ/space SS	
Reopened	
Reason for reopen	
Sepsis	
Suture line failu	
Fascial dehiscen	

	Posterior Probability
Hospital-free days	72%
ICU-free days	77%
Ventilator-free day	72%



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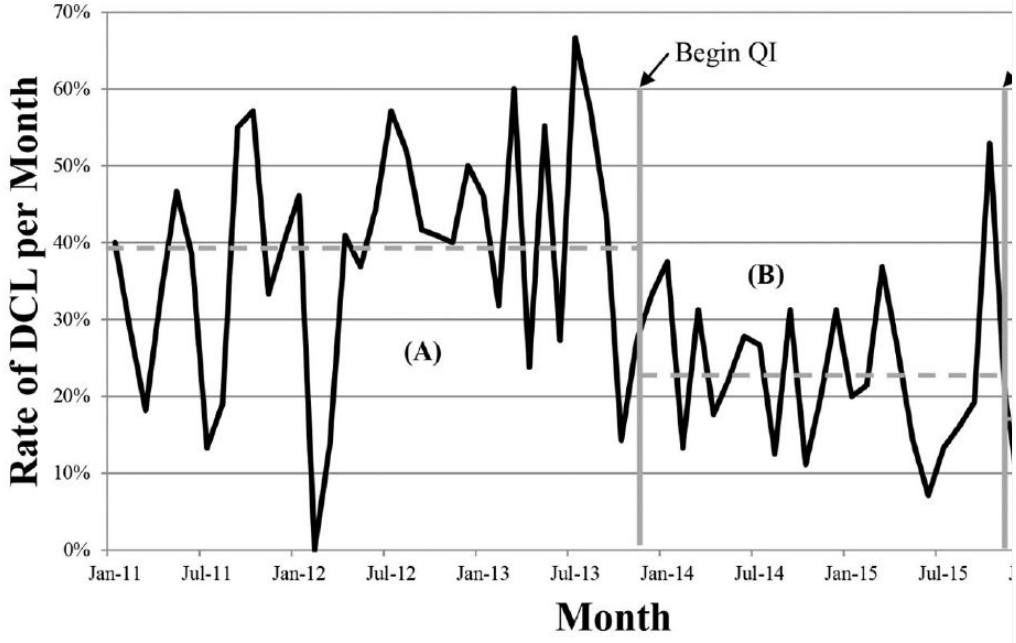
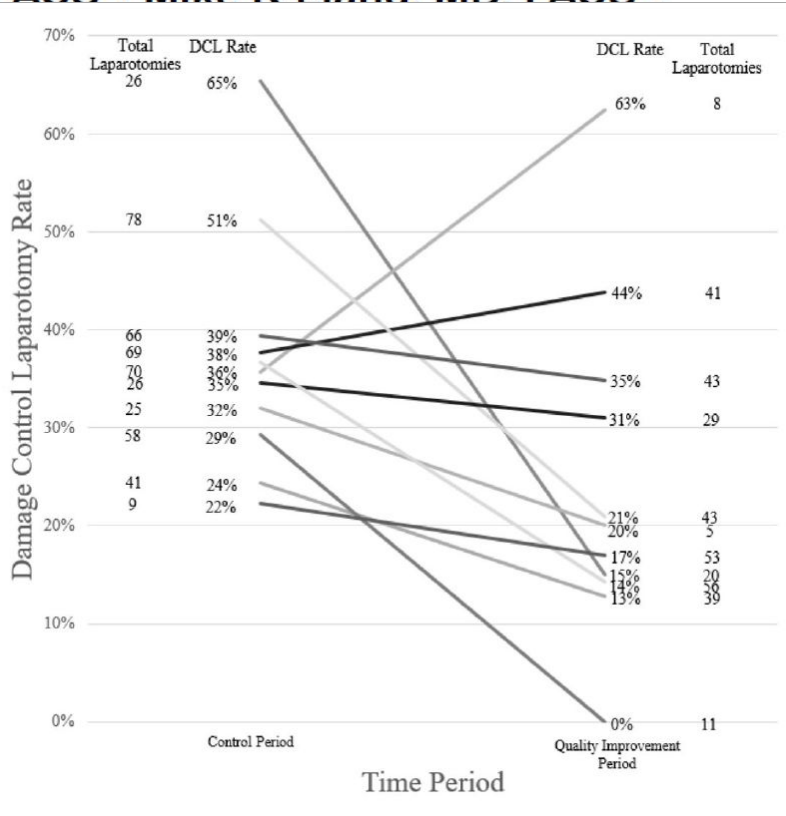
Decreasing the Use of Damage Control Laparotomy in Trauma: A Quality Improvement Project

John A Harvin, MD, FACS[1,2], Lillian S Kao, MD, MS, FACS[1], Mike K Liang, MD, FACS[1]
Sasha D Adams, MD, FACS[1,2], Michelle K McNutt, I
Laura J Moore. MD. FACS[1,2]. Charles E Wade. PhD



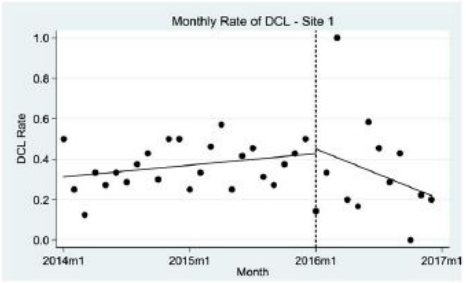


Better Understa ontrol Laparotomy: a ment Project:

The Multi-Institutiona

John A Harvin, MD, M lichael D Goodman, MD[3], Timothy A Pritts Moran, MD[4], Rachel D Rodriguez, MD[5], Be effrey A Claridge, MD[6], John B Holcom

(1)



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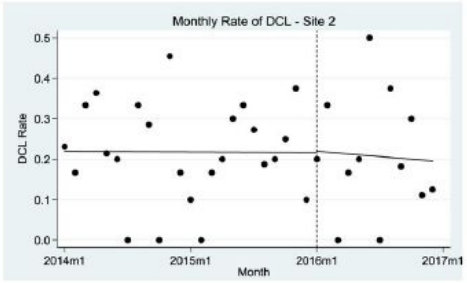

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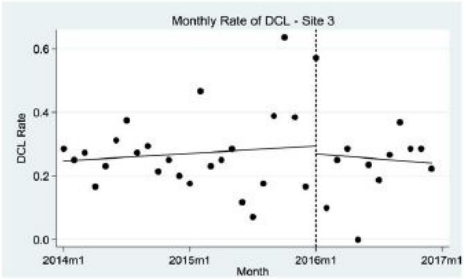

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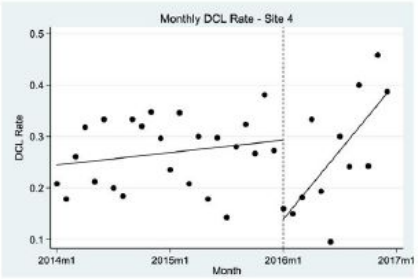

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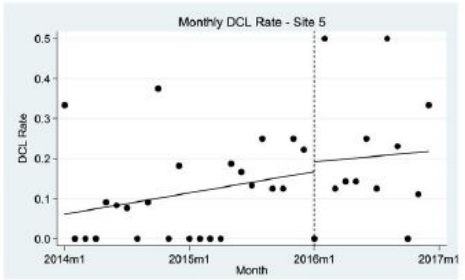

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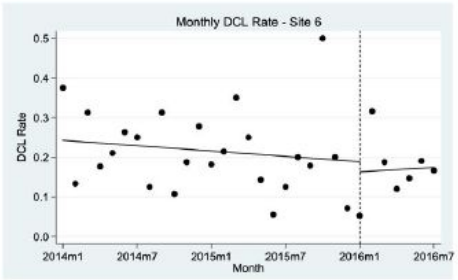


Site-Sp

Site	al Rate of DCL	Difference between Actual and Ideal
1	27%	7%
2	16%	4%
3	18%	8%
4	21%	6%
5	15%	4%
6	13%	3%
All	19%	5%

Historical Management

- Complex repairs
- Long operative times
- Massive volume resuscitation

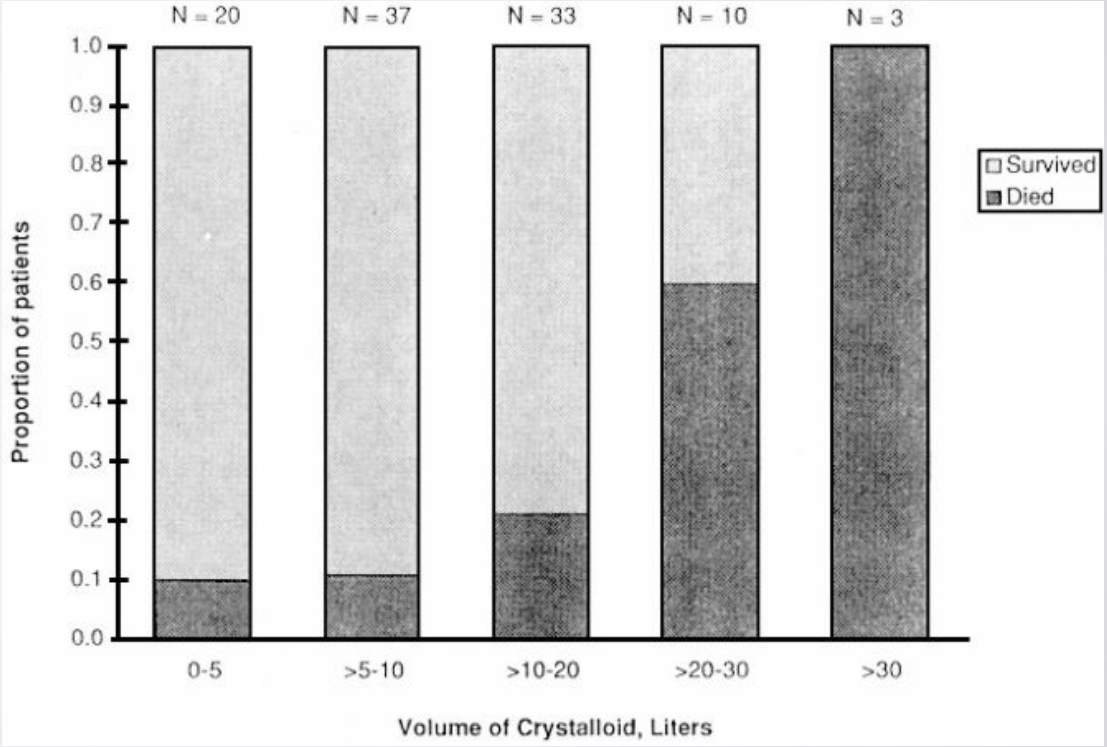
1970s-2000s

Classification of Hemorrhagic Shock

	Class I	Class II	Class III	Class IV
Blood Loss (%)	<15%	15-30%	31-40%	>40%
Heart rate	60-100	101-120	121-140	>140
Blood Pressure	Normal	Normal	Decreased	Decreased
Mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic
Fluid requirements	Crystalloid	Crystalloid	Crystalloid, blood products	Crystalloid, blood products

Mortality rates

- 1970s: 90%
- 1980s: 80%
- 1990s: 50%



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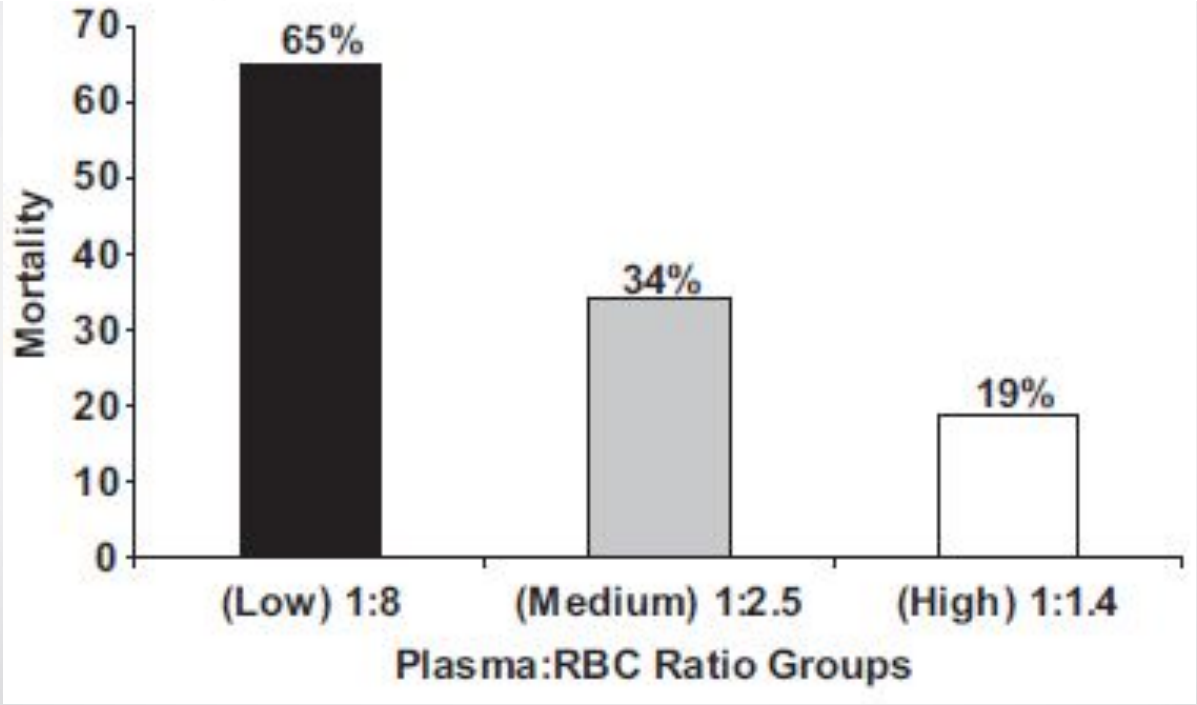
Heckbert S, Vedder N, Hoffman W, et al. Outcome after hemorrhagic shock in trauma patients. **J Trauma.** 1998 Sept; 45(3): 545-549.

The Ratio of Blood Products Transfused Affects Mortality in Patients Receiving Massive Transfusions at a Combat Support Hospital

Matthew A. Borgman, MD, Philip C. Spinella, MD, Jeremy G. Perkins, MD, Kurt W. Grathwohl, MD, Thomas Repine, MD, Alec C. Beekley, MD, James Sebesta, MD, Donald Jenkins, MD, Charles E. Wade, PhD, and John B. Holcomb, MD



Borgman M, Spinella P, Perkins J, et al. The ratio of blood products transfused affects mortality in patients receiving massive transfusions at a combat support hospital. J Trauma Acute Care Surg. 2007;63: 805-813.

Damage Control Hematology: The Impact of a Trauma Exsanguination Protocol on Survival and Blood Product Utilization

Bryan A. Cotton, MD, Oliver L. Gunter, MD, James Isbell, MD, Brigham K. Au, BS, Amy M. Robertson, MD, John A. Morris, Jr., MD, Paul St. Jacques, MD, and Pampee P. Young, MD, PhD

Optimizing Outcomes in Damage Control Resuscitation: Identifying Blood Product Ratios Associated With Improved Survival

Oliver L. Gunter, Jr., MD, Brigham K. Au, BS, James M. Isbell, MD, Nathan T. Mowery, MD, Pampee P. Young, MD, PhD, and Bryan A. Cotton, MD

Postinjury Life Threatening Coagulopathy: Is 1:1 Fresh Frozen Plasma: Packed Red Blood Cells the Answer?

Jeffry L. Kashuk, MD, Ernest E. Moore, MD, Jeffrey L. Johnson, MD, James Haenel, RRT, Michael Wilson, MD, John B. Moore, MD, C. Clay Cothren, MD, Walter L. Biffl, MD, Anirban Banerjee, PhD, and Angela Sauaia, MD, PhD

Review of Current Blood Transfusions Strategies in a Mature Level I Trauma Center: Were We Wrong for the Last 60 Years?

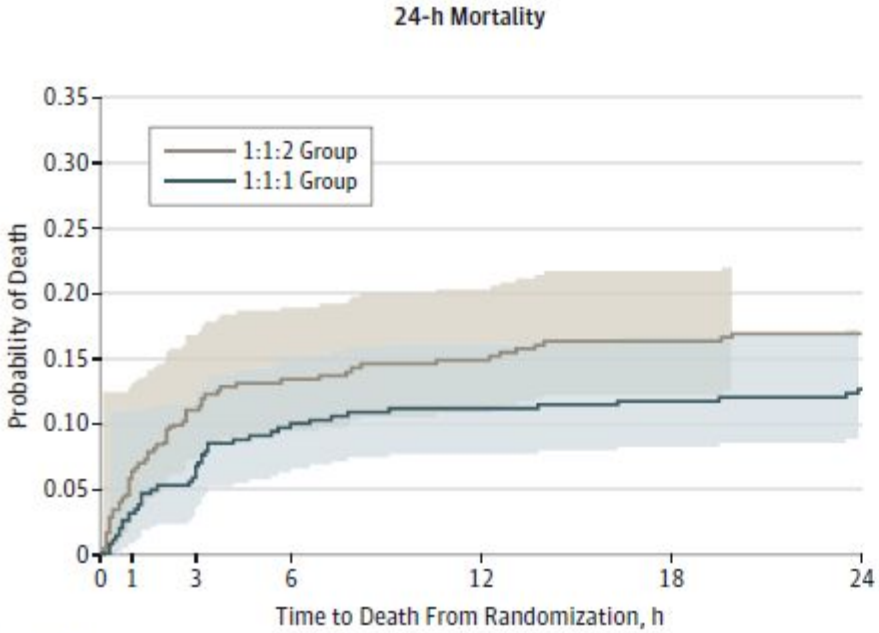
Juan C. Duchesne, MD, John P. Hunt, MD, MPH, Georgia Wahl, MD, NREMT-P, Alan B. Marr, MD, Yi-Zarn Wang, DDS, MD, Sharon E. Weintraub, MD, MPH, Mary J. O. Wright, MD, and Norman E. McSwain, Jr., MD

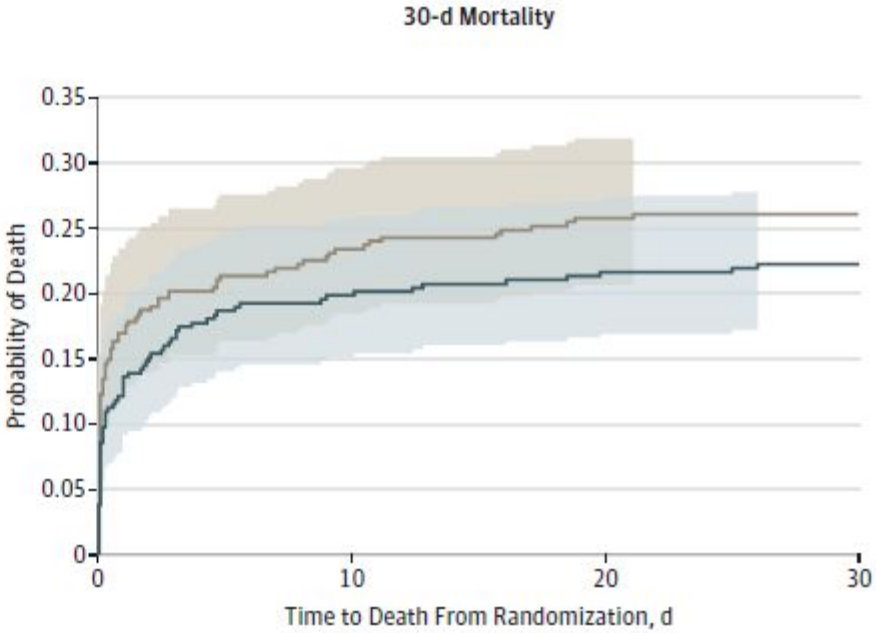
Fresh Frozen Plasma Should be Given Earlier to Patients Requiring Massive Transfusion

Ernest A. Gonzalez, MD, Frederick A. Moore, MD, John B. Holcomb, MD, Charles C. Miller, PhD, Rosemary A. Kozar, MD, PhD, S. Rob Todd, MD, Christine S. Cocanour, MD, Bjorn C. Balldin, MD, and Bruce A. McKinley, PhD

Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma

The PROPPR Randomized Clinical Trial





No. at risk

1:1:2	342	322	304	296	291	286	284	342	261	253	252
1:1:1	338	327	318	305	300	297	295	338	269	263	260


HESPAN
6% hetastarch in 0.9%
odium chloride injection)
BRAUN
EXP 13 4 LOT J1E496
Sodium Chloride
ion USP
1000 mL
B BRAUN
0.9% Sodium Chloride
Injection USP
250 mL
EXP 02/20 LOT J7K792
0.9% Sodium Chloride
Injection USP
1000 mL
ALBUMIN-GCC
50ml/20%

f Crystalloid

Burlew CC. The open abdomen: practical implications for the practicing surgeon. **Am J Surg.** 2012; 204: 826-835.

Improving mortality in trauma laparotomy through the evolution of damage control resuscitation: Analysis of 1,030 consecutive trauma laparotomies

Bellal Joseph, MD, Asad Azim, MD, Bardiya Zangbar, MD, Zachary Bauman, MD, Terence O'Keeffe, MD, Kareem Ibraheem, MD, Narong Kulvatunyou, MD, Andrew Tang, MD, Riaft Latifi, MD, *and* **Peter Rhee, MD**, *Tucson, Arizona*

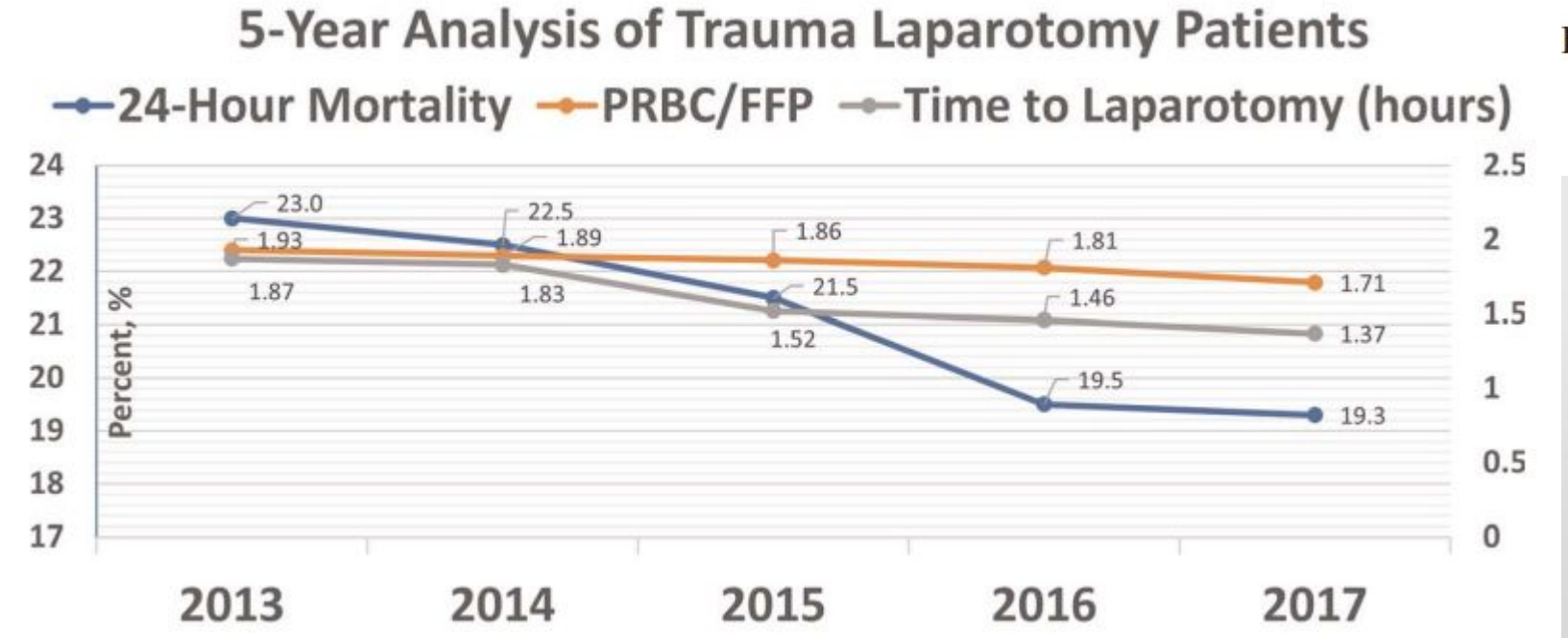
	Pre-DCR	Transient	Post-DCR
Variables	**Pre-DCR (n = 265)**	**Transient (n = 261)**	**Post-DCR (n = 504)**	***P***
Complications, %	38	20	19	0.001**
ACS, %	5	1.1	0.3	0.001**
ARDS, %	3.4	1.1	1.7	0.3**
Infectious, %	23.4	15.7	13.4	0.01**
Mortality, %	17	10	11	0.001**
Hospital LOS (d), median [IQR]	7 [4–19]	6 [4–12]	6 [3–12]	0.03*
ICU LOS (d), median [IQR]	4 [2–10]	2 [1–4]	1 [1–3]	<0.001*
Hospital costs ($), median [IQR]	25,738 [14,829–57,182]	20,706 [12,052–39,961]	18,656 [10,868–37,406]	0.04*
FFP/platelet/PRBC	10: 8: 17	12: 10: 15	7: 7: 8	

1. Joseph B, Azim A, Zangbar B, et al. Improving mortality in trauma laparotomy through the evolution of damage control resuscitation: Analysis of 1,030 consecutive trauma laparotomies. **JTACS**. 2017 Feb; 82(2): 328-333.

After 9,000 laparotomies for blunt trauma, resuscitation is becoming more balanced and time to intervention shorter: Evidence in action

Molly D

FACS,



1. Douglas M, Obaid O, Castanon L, et al. After 9,000 laparotomies for blunt trauma, resuscitation is becoming more balanced and time to intervention shorter: Evidence in action. **JTACS**, 93 (3), 307-315

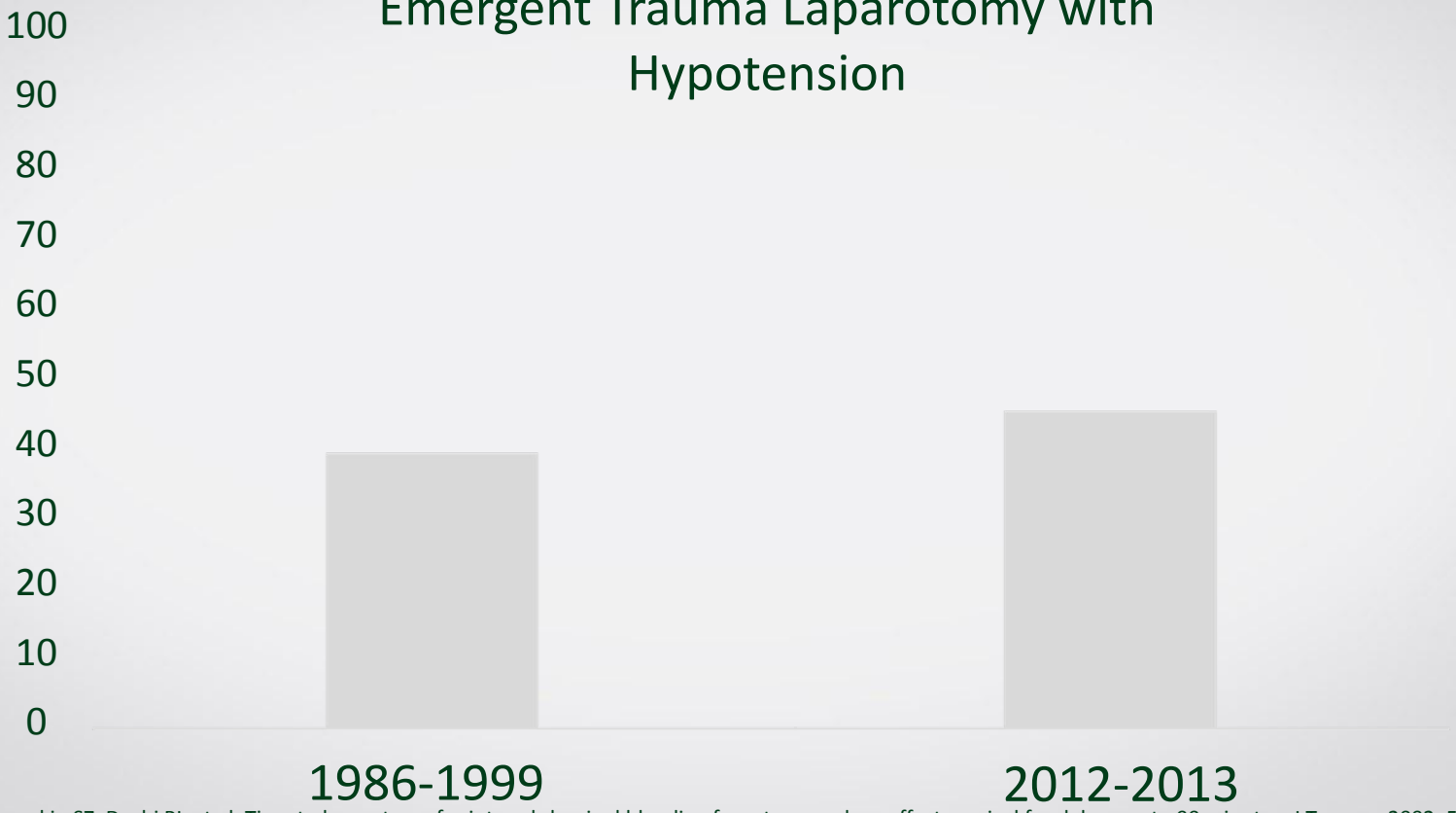
Mortality after emergent trauma laparotomy: A multicenter, retrospective study

John A. Harvin, MD, Tom Maxim, Kenji Inaba, MD, Myriam A. Martinez-Aguilar, MD, David R. King, MD, Asad J. Choudhry, MD, Martin D. Zielinski, MD, Sam Akinyeye, MD, S. Rob Todd, MD, Russell L. Griffin, PhD, Jeffrey D. Kerby, MD, PhD, Joanelle A. Bailey, MD, David H. Livingston, MD, Kyle Cunningham, MD, Deborah M. Stein, MD, Lindsay Cattin, MPH, Eileen M. Bulger, MD, Alison Wilson, MD, Vicente J. Undurraga Perl, MD, Martin A. Schreiber, MD, Jill R. Cherry-Bukowiec, MD, Hasan B. Alam, MD, *and* **John B. Holcomb, MD**, *Houston, Texas*

1. Harvin JA, Maxim T, Inaba K, et al. Mortality following emergent trauma laparotomy: a multicenter, retrospective study. J Trauma Acute Care Surg. 2017 Sep; 83(3):464-468.

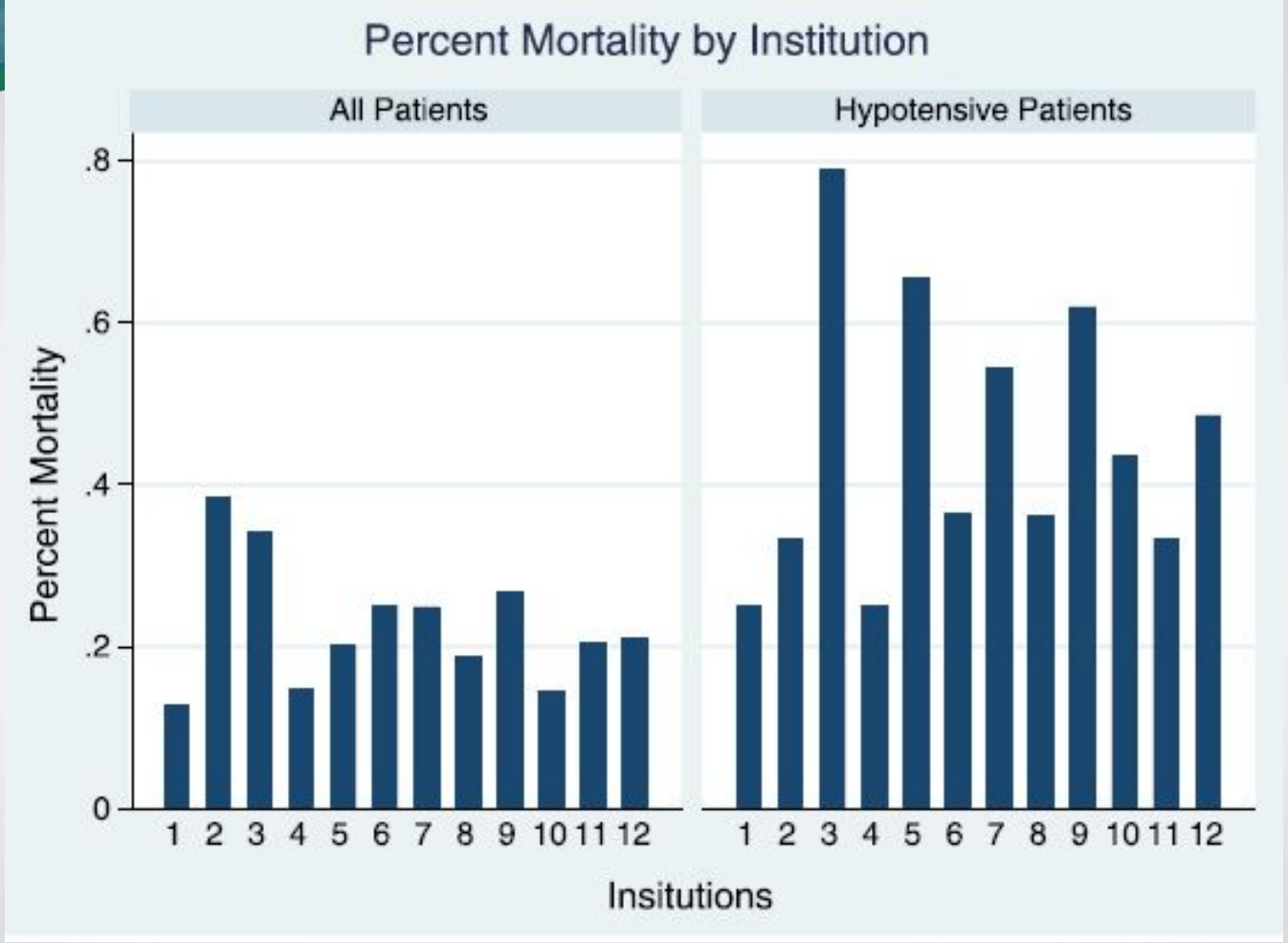
Mortality

Emergent Trauma Laparotomy with Hypotension

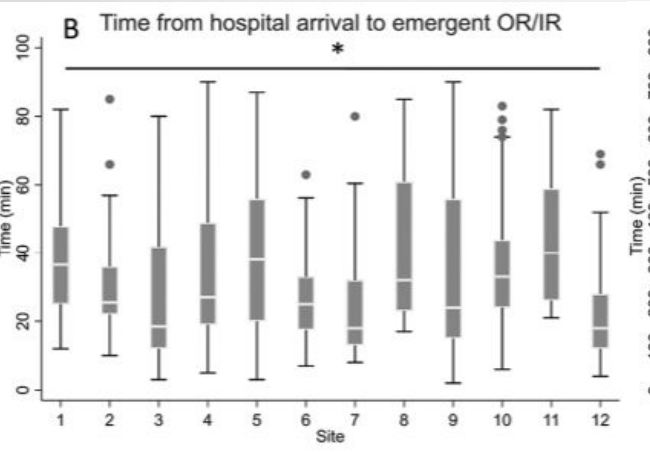


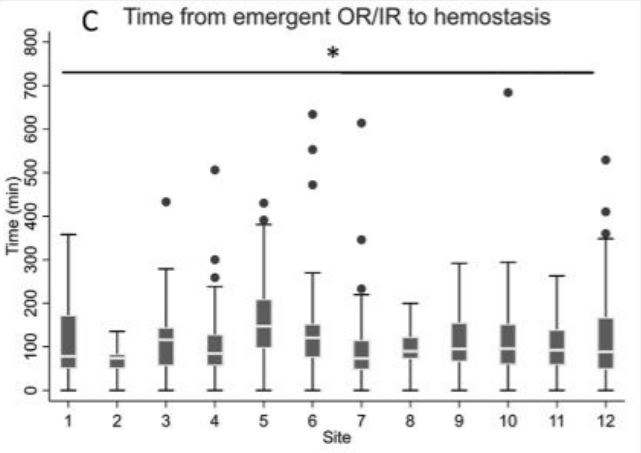
1. Clarke JR, Trooskin SZ, Doshi PJ, et al. Time to laparotomy for intra-abdominal bleeding from trauma does affect survival for delays up to 90 minutes. J Trauma. 2002; 52(3):420-425.

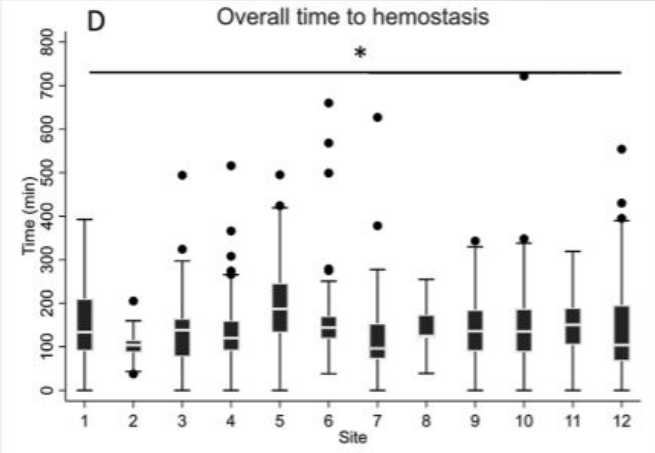
2. Harvin JA, Maxim T, Inaba K, et al. Mortality following emergent trauma laparotomy: a multicenter, retrospective study. J Trauma Acute Care Surg. 2017 Sep; 83(3):464-468.



1. Harvin JA, Maxim T, Inaba K, et al. Mortality following emergent trauma laparotomy: a multicenter, retrospective study. J Trauma Acute Care Surg. 2017 Sep; 83(3):464-468.

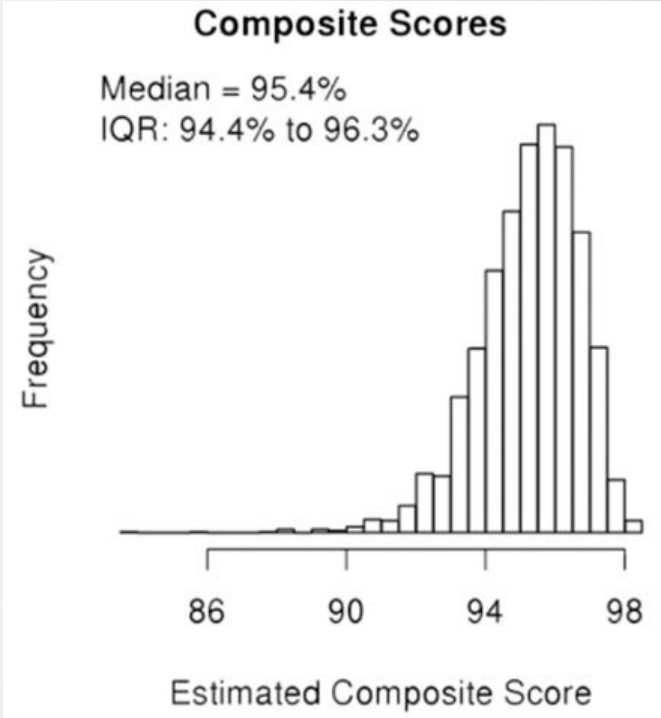






Chang R, Kerby JD, Kalkwarf KJ, et al. Earlier time to hemostasis is associated with decreased mortality and rate of complications: results from the Pragmatic Randomized Optimal Platelet and Plasma Ratio (PROPPR) trial. J Trauma Acute Care Surg. 2015 Aug; 79(2):312-319.

- Individual surgeon performance metrics
  - Coronary artery bypass grafting
  - Valve replacements
  - Overall operative composite score



Shahian DM, He X, Jacobs JP, et al. The Society of Thoracic Surgeons composite measure of individual surgeon performance for adult cardiac surgery: A report of the Society of Thoracic Surgeons quality measurement task force. Ann Thorac Surg. 2015; 100(4): 1324-5.

It is time to look in the mirror: Individual surgeon outcomes after emergent trauma laparotomy

Parker Hu, MD, Jan O. Jansen, MBBS, PhD, Rindi Uhlich, MD, MSPH, Zain G. Hashmi, MBBS, Rondi B. Gelbard, MD, Jeffrey Kerby, MD, PhD, Daniel Cox, MD, *and* John B. Holcomb, MD,
Birmingham, Alabama

Hypothesis

- Individual trauma surgeons may significantly impact mortality in patients requiring emergent trauma laparotomy

- Retrospective review
- November 2019 to February 2021
- Patients receiving emergent trauma laparotomy

Emergent Trauma Laparotomy

- Exploration from trauma bay for possible hemorrhage control

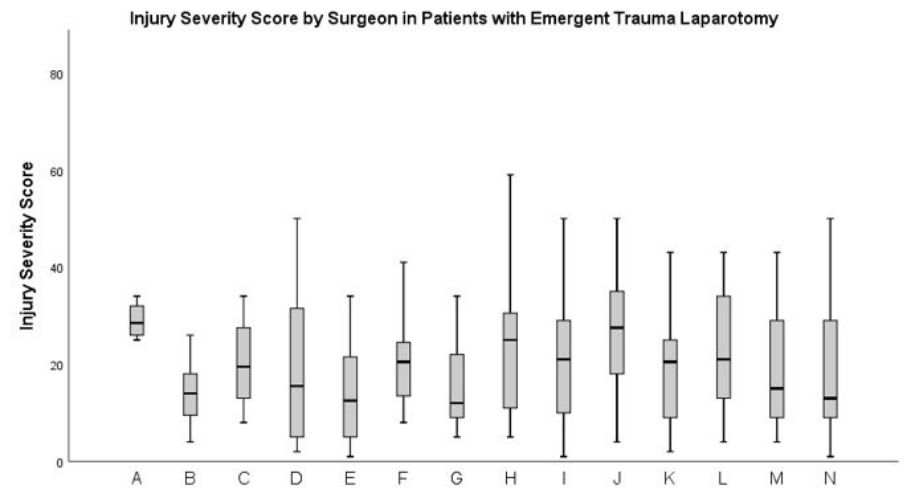
- Highest OR activation level (1/Immediate)

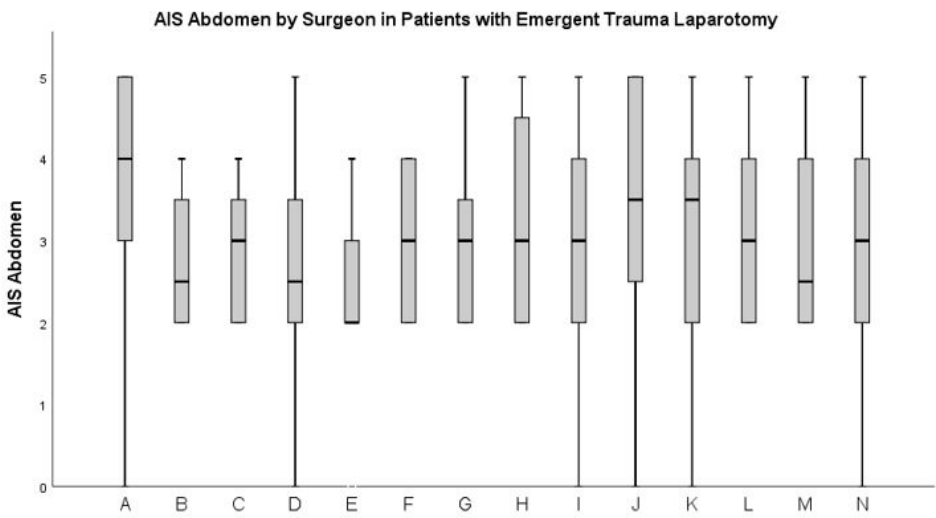
Comparison of outcomes by surgeon at index operation

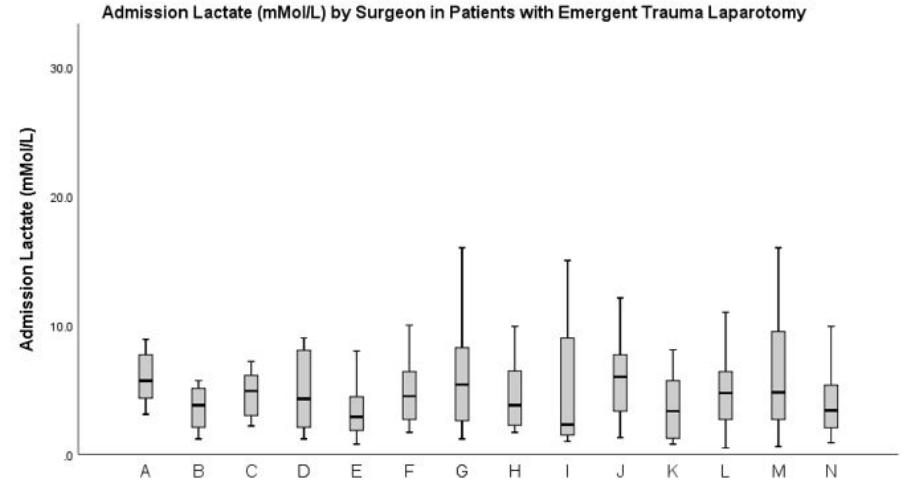
- Main outcome: 24-hour mortality

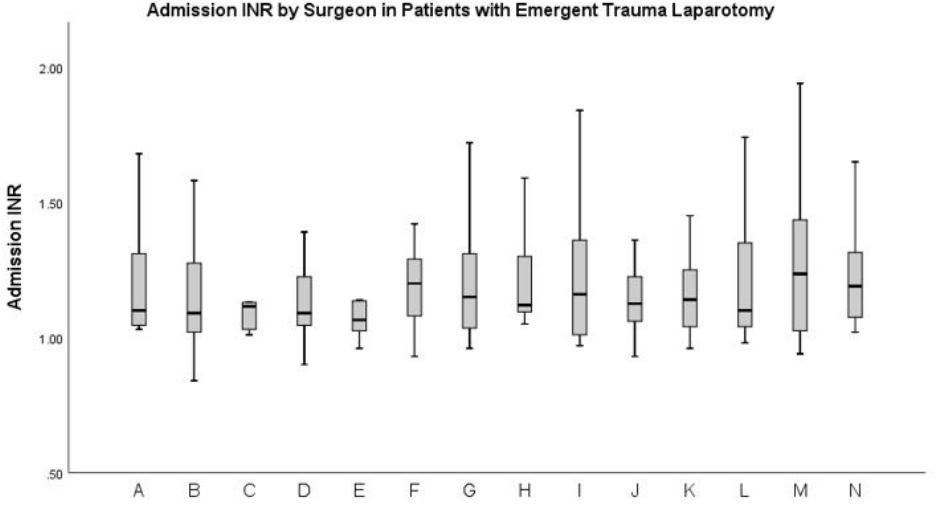
Fourteen full time faculty

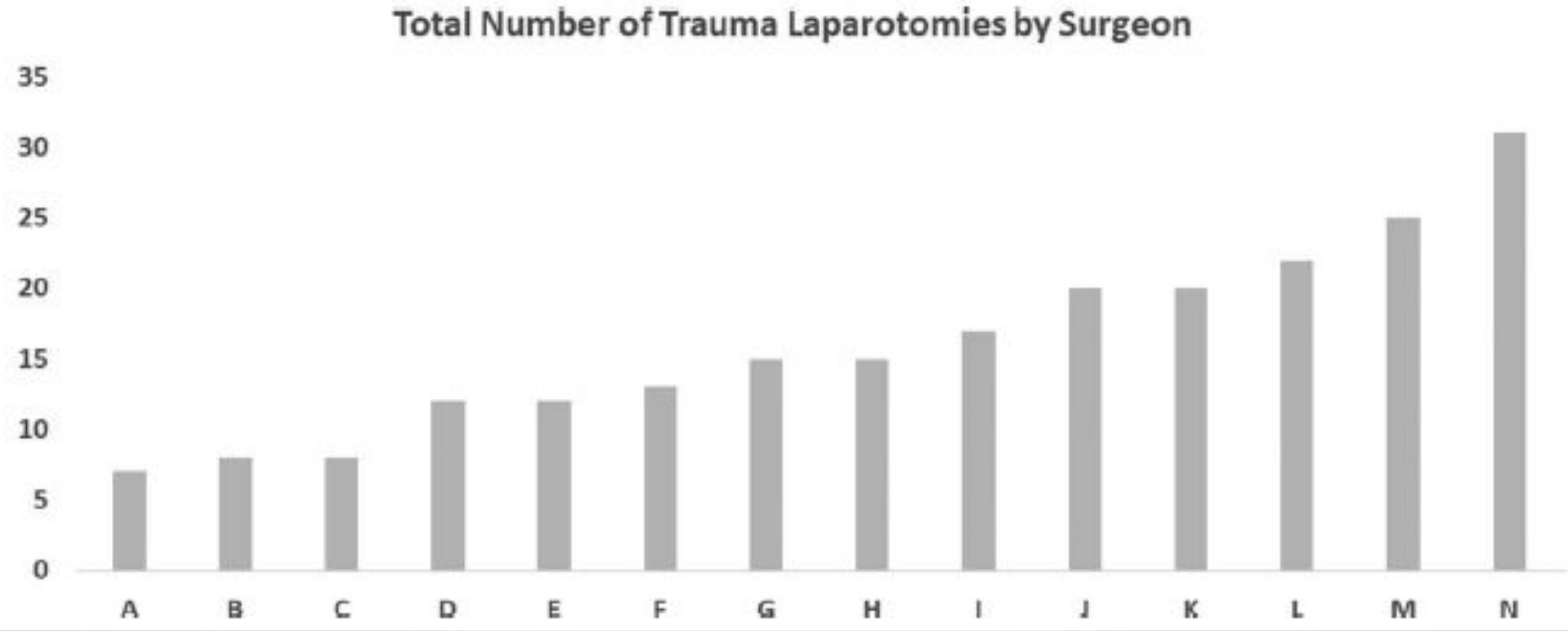
- Years of faculty experience: 2-22 years; median 10 years
- Fellowship trained: 79%
- FACS: 71%
- Fellow of the AAST: 43%

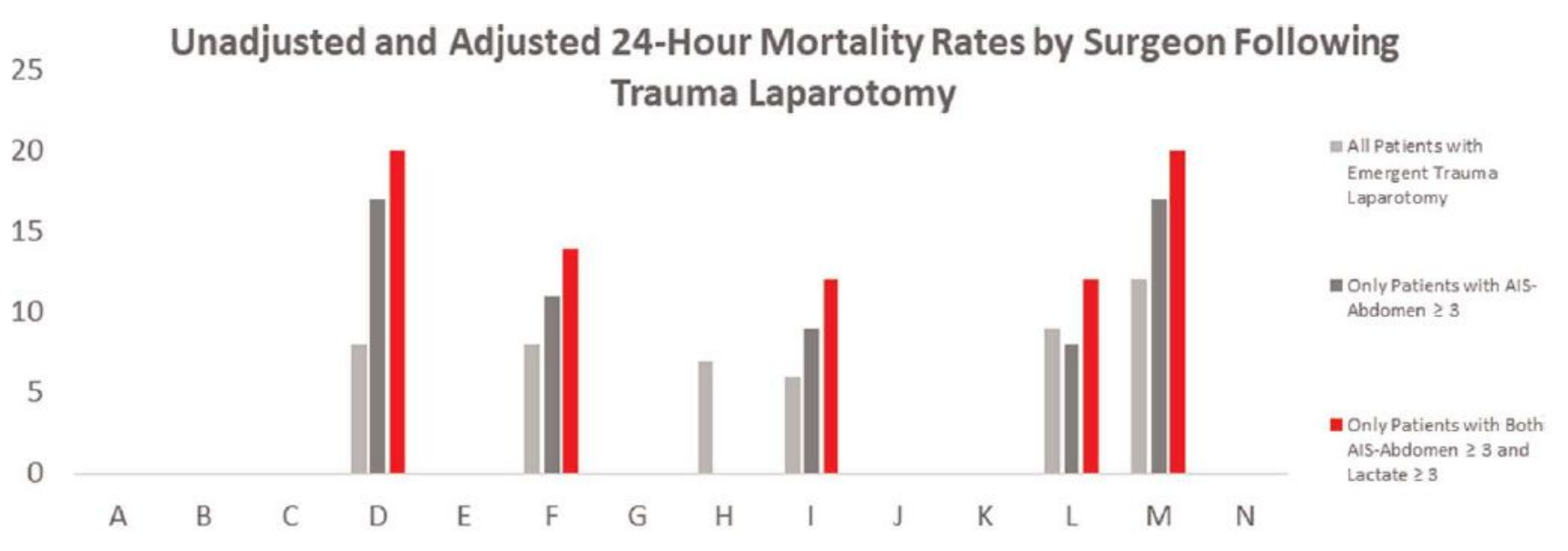

Injury Severity Score by Surgeon in Patients with Emergent Trauma Laparotomy
Injury Severity Score
0
20
40
60
80
A
B
C
D
E
F
G
H
I
J
K
L
M
N

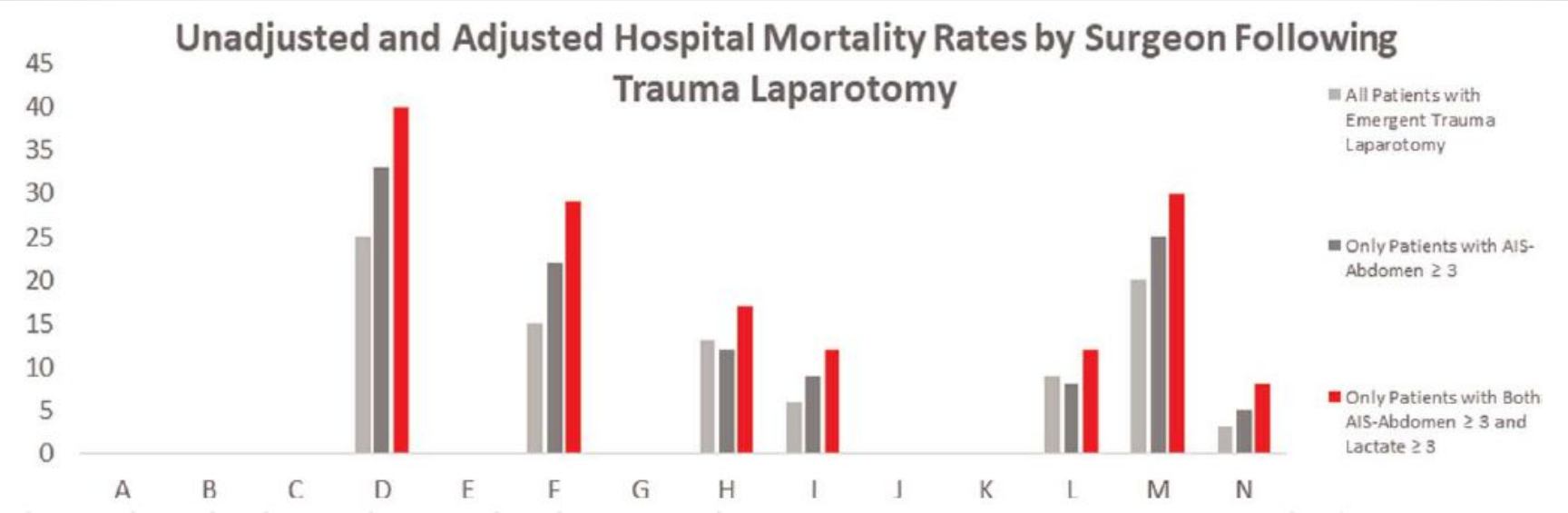

AIS Abdomen by Surgeon in Patients with Emergent Trauma Laparotomy
AIS Abdomen
0
1
2
3
4
5
A
B
C
D
E
F
G
H
I
J
K
L
M
N


Admission Lactate (mMol/L) by Surgeon in Patients with Emergent Trauma Laparotomy
Admission Lactate (mMol/L)
.0
10.0
20.0
30.0
A
B
C
D
E
F
G
H
I
J
K
L
M
N


Admission INR by Surgeon in Patients with Emergent Trauma Laparotomy
Admission INR
.50
1.00
1.50
2.00
A
B
C
D
E
F
G
H
I
J
K
L
M
N


Total Number of Trauma Laparotomies by Surgeon
35
30
25
20
15
10
5
0
A
B
C
D
E
F
G
H
I
J
K
L
M
N




Unadjusted and Adjusted Hospital Mortality Rates by Surgeon Following Trauma Laparotomy
45
40
35
30
25
20
15
10
5
0
A
B
C
D
E
F
G
H
I
J
K
L
M
N
All Patients with Emergent Trauma Laparotomy
Only Patients with AIS-Abdomen ≥ 3
Only Patients with Both AIS-Abdomen ≥ 3 and Lactate ≥ 3

Limitations

- Lower mortality than other recent works
- Limited sample size
- Site specific inclusion criteria

Comparing individual surgeon outcomes

- Retrospective review 2019-2022
- ETL: laparotomy within 90 minutes of arrival
  - Excluding ED thoracotomy
- Funnel plot analysis to assess mortality rates with 95% and 99.7% confidence intervals

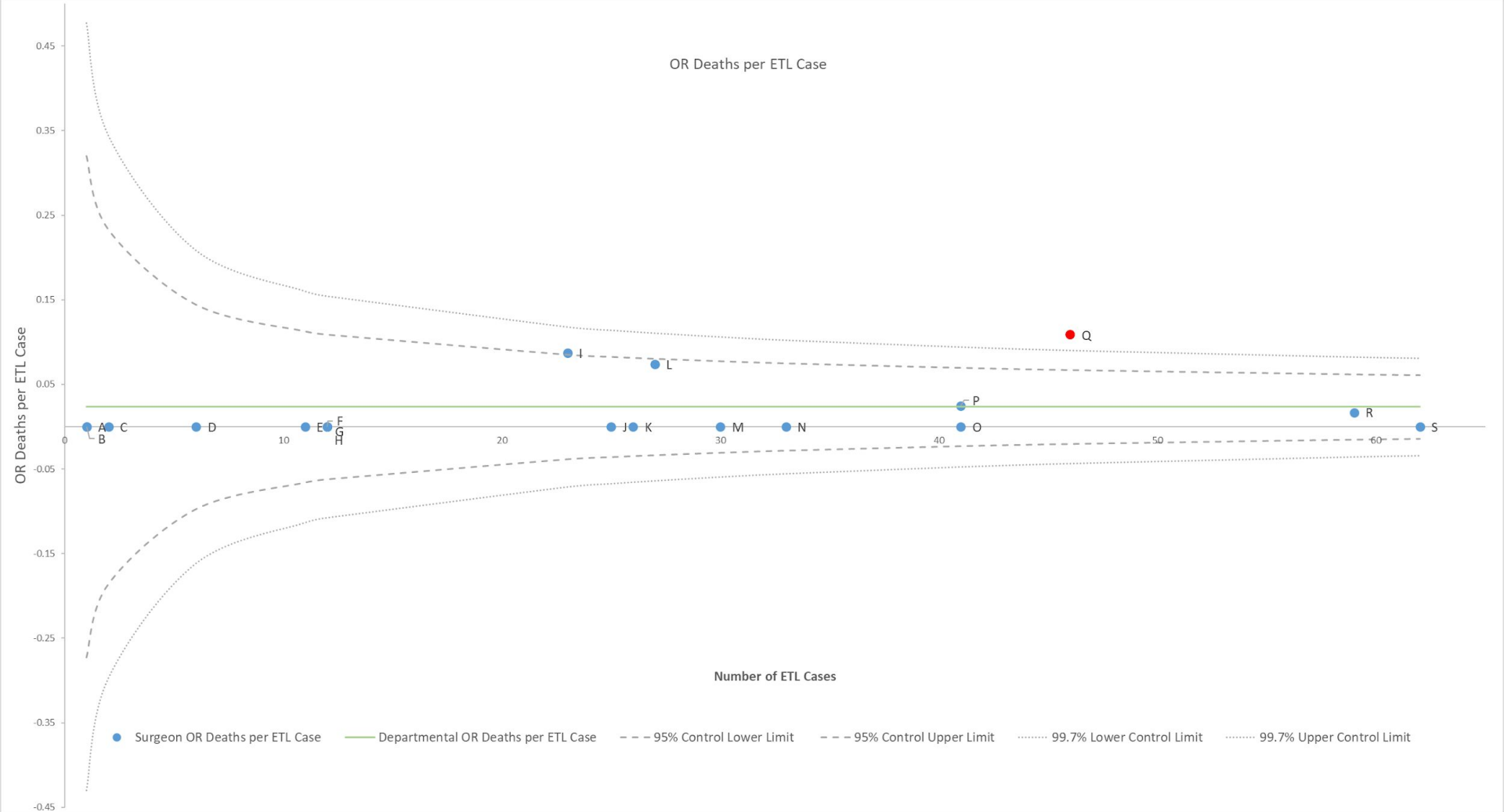
Comparing individual surgeon outcomes

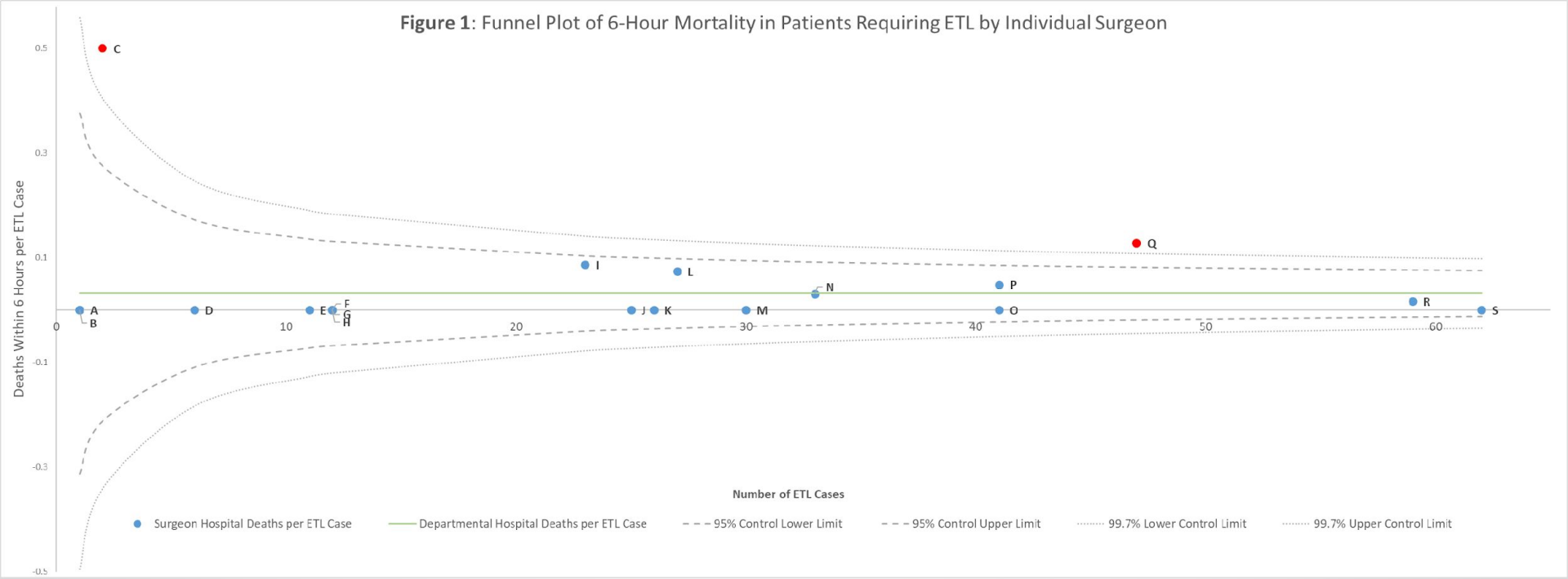
- 471 ETL by 19 faculty
- Median 25, range 1-62
- 21% (100/471) hypotensive (SBP <90 mmHg) on arrival

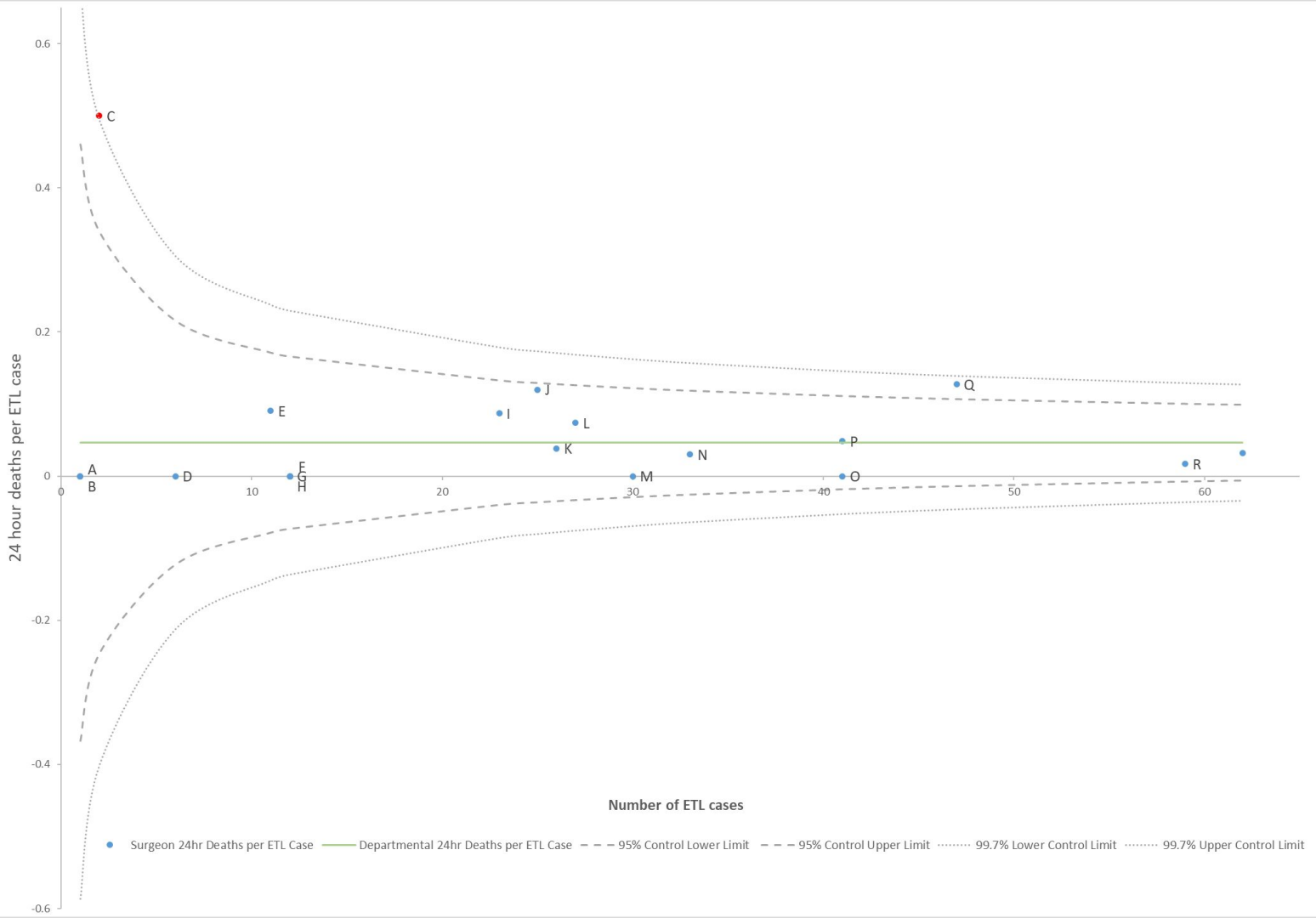
Comparing individual surgeon outcomes

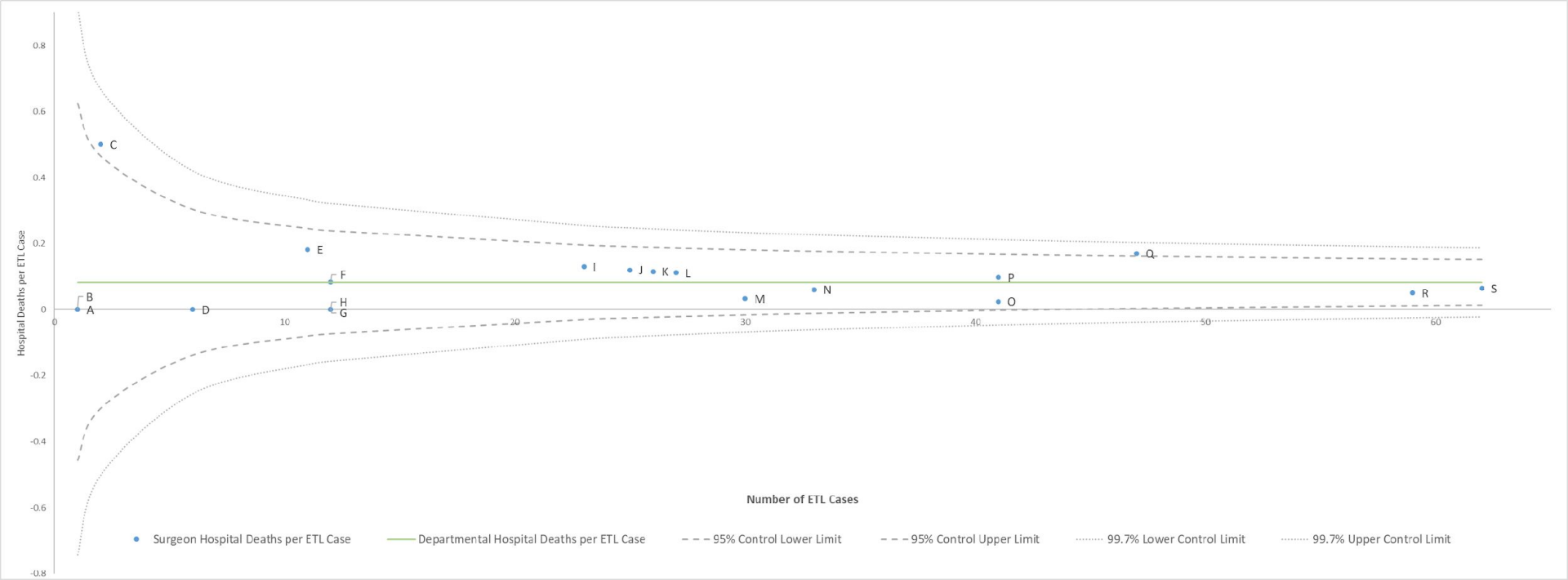
- No difference in presenting patient characteristics, vitals, labs or injury severity

- Overall mortality:
  - OR 2%
  - 6-Hour 3%
  - 24-Hour 5%
  - Hospital 8%


OR Deaths per ETL Case
OR Deaths per ETL Case
0.45
0.35
0.25
0.15
0.05
-0.05
-0.15
-0.25
-0.35
-0.45
0
10
20
30
40
50
60
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
Number of ETL Cases
Surgeon OR Deaths per ETL Case
Departmental OR Deaths per ETL Case
95% Control Lower Limit
95% Control Upper Limit
99.7% Lower Control Limit
99.7% Upper Control Limit




0.6
0.4
0.2
0
-0.2
-0.4
-0.6
24 hour deaths per ETL case
0
10
20
30
40
50
60
Number of ETL cases
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
Surgeon 24hr Deaths per ETL Case
Departmental 24hr Deaths per ETL Case
95% Control Lower Limit
95% Control Upper Limit
99.7% Lower Control Limit
99.7% Upper Control Limit


Hospital Deaths per ETL Case
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
10
20
30
40
50
60
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
Number of ETL Cases
Surgeon Hospital Deaths per ETL Case
Departmental Hospital Deaths per ETL Case
95% Control Lower Limit
95% Control Upper Limit
99.7% Lower Control Limit
99.7% Upper Control Limit

Comparing individual surgeon outcomes

- Probable outliers in early mortality
- Outliers despite accounting for patient severity and case volume

Learning Through Loss: Characterizing Patient Deaths After Emergent Trauma Laparotomy

Hu P, Uhlich RM, Jansen JO, Cox DB, Kerby JD, Holcomb JB

- Retrospective, single center: 11/2019 – 12/2021
- ETL = laparotomy within 90 minutes of arrival
- Hospital mortality vs survival

Methods

- All deaths evaluated by PI committee
  - Classified by likely cause of death
  - Possible areas for improvement

- Potentially preventable hemorrhage death
  - Minimum: Arrived with pulse or died following operation

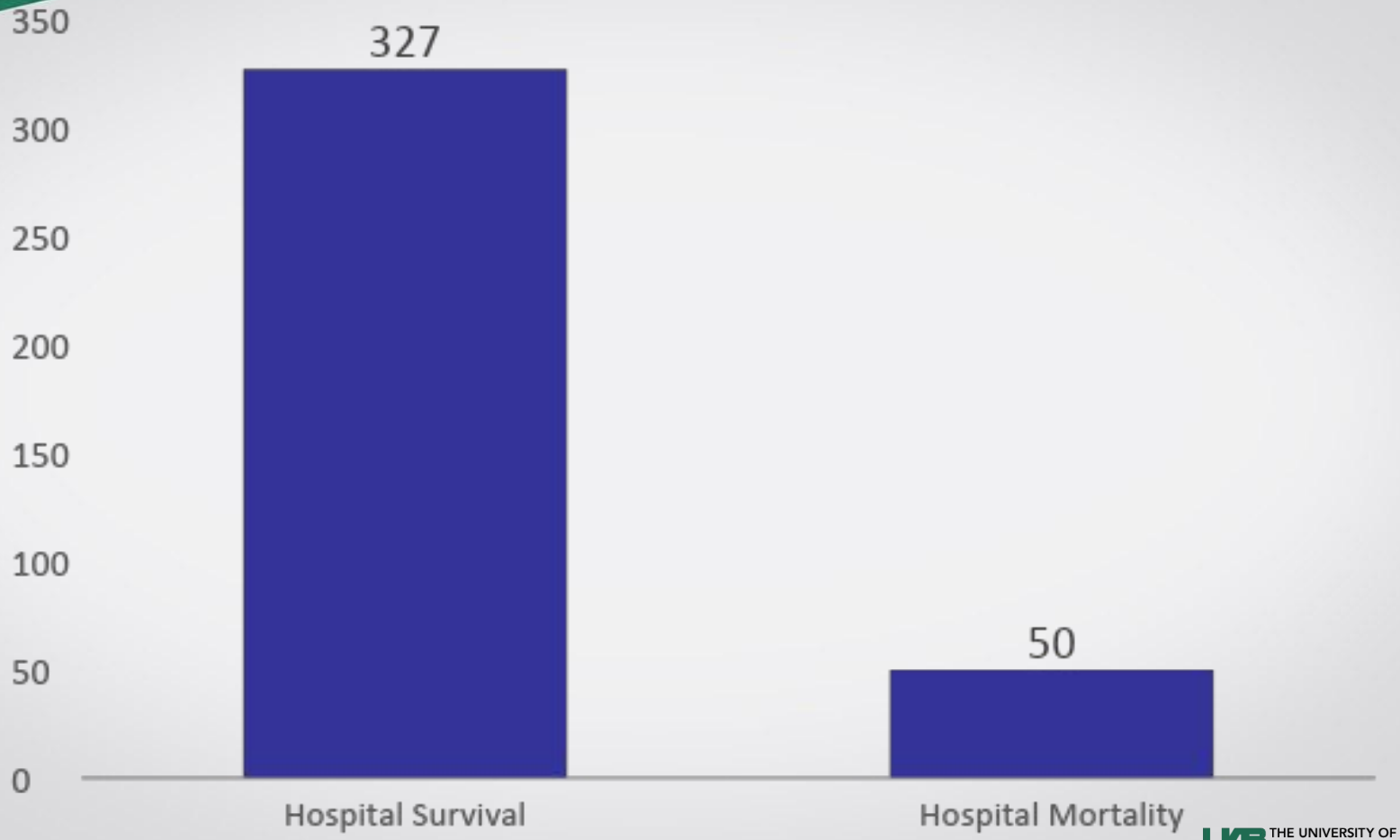
Methods

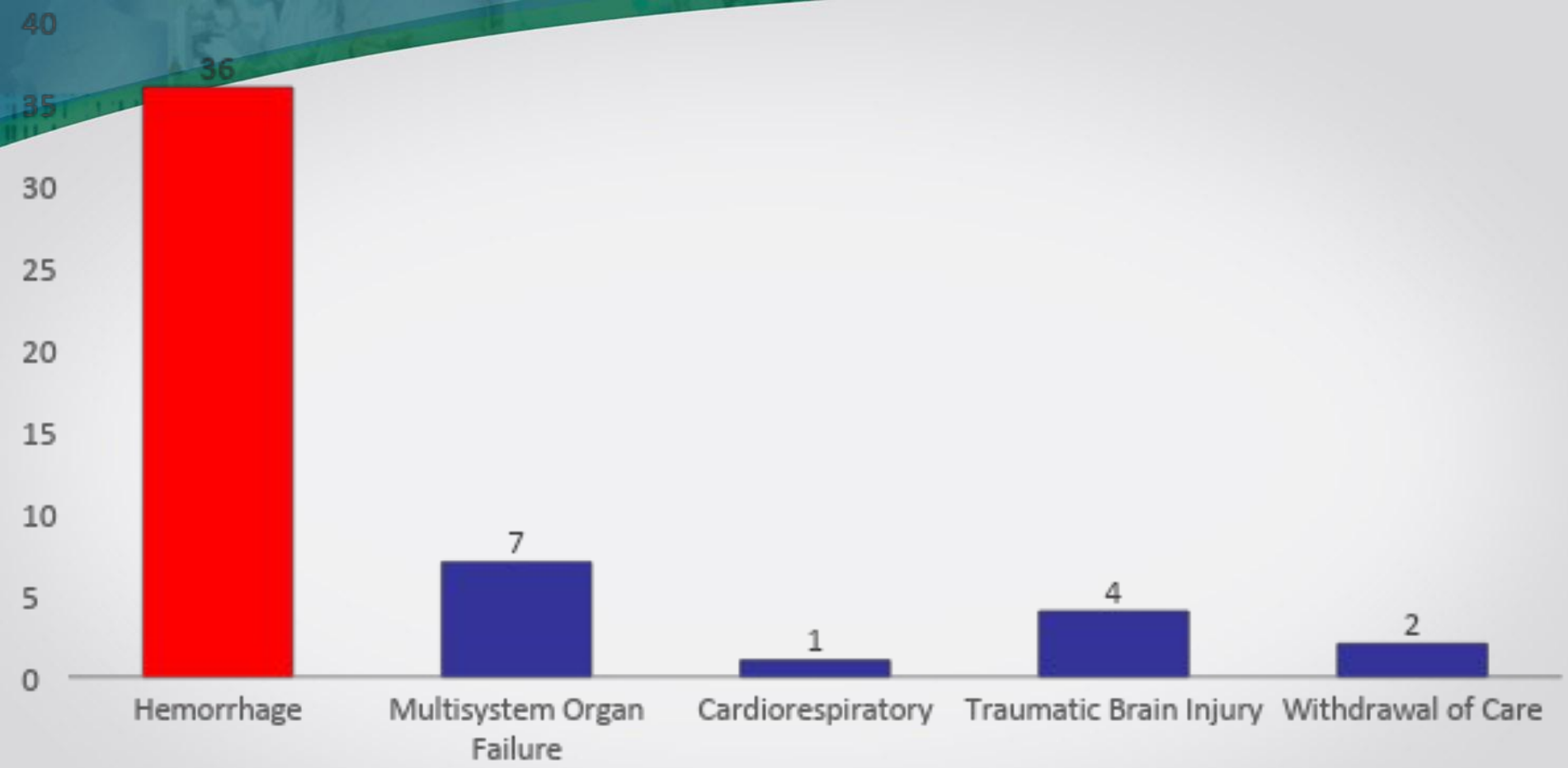
Areas for Improvement (possible >1)

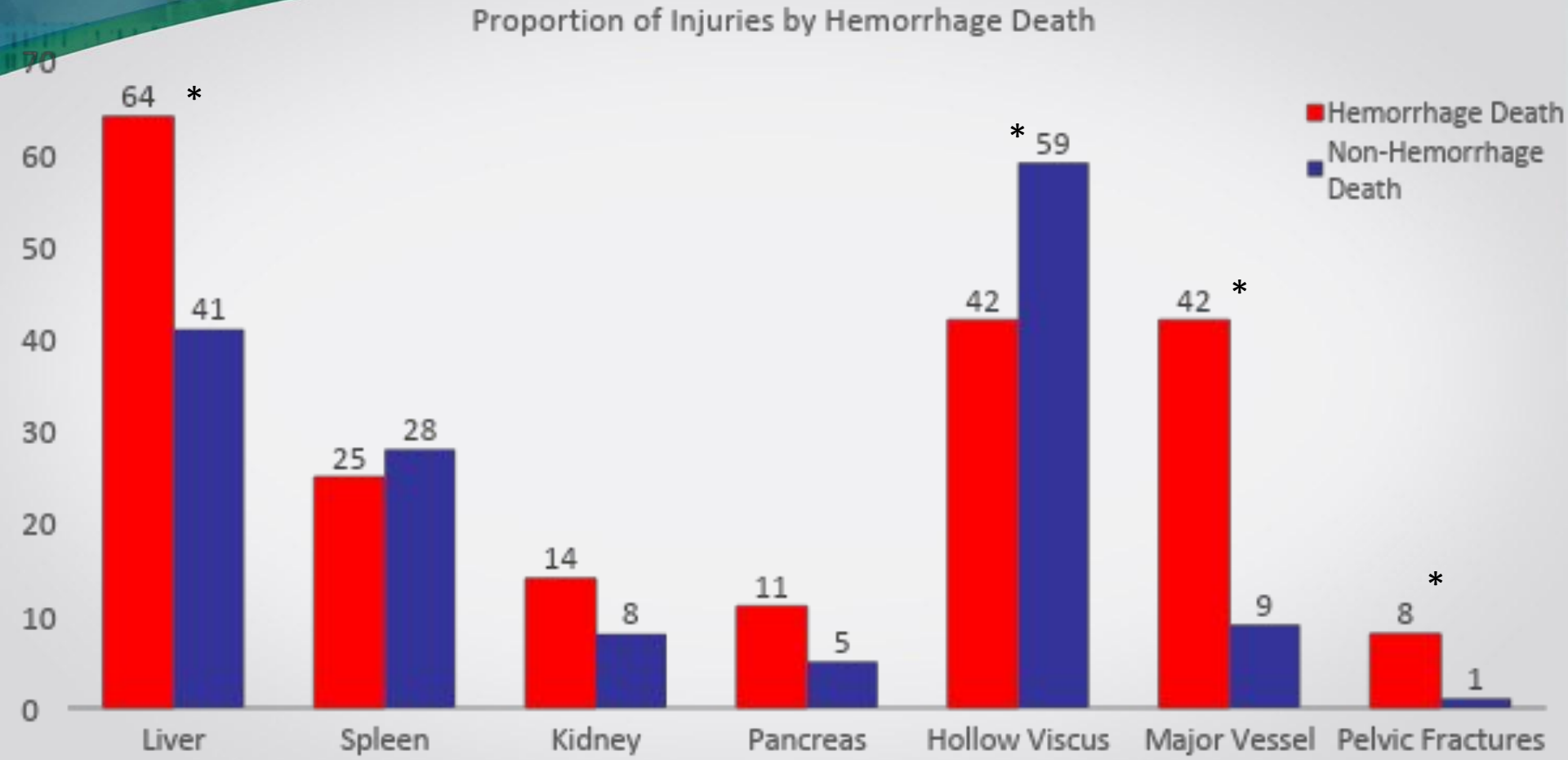
- Prehospital
- Trauma Bay
- Operating Room
  - Technical
  - Decision Making
- ICU

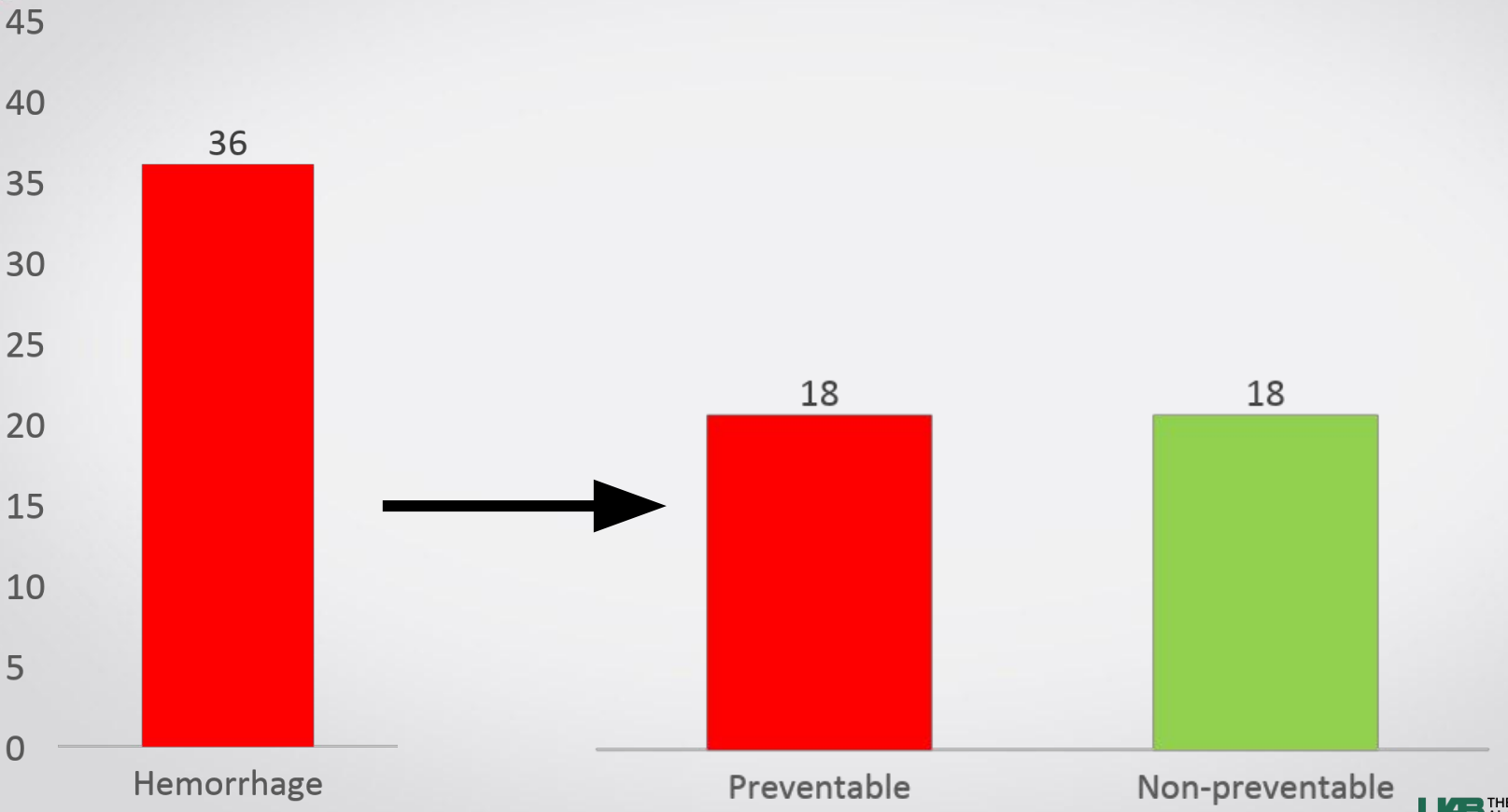
Results

- 377 patients
  - 82% male
  - 73% penetrating
  - 80% from scene
  - 8% resuscitative thoracotomy









Preventable vs Non-Preventable Hemorrhage Death

Prehospital transport method

- p=0.34

Direct from scene

- 89% vs 89% (p=1.0)

Hypotensive on arrival

- 50% vs 94% (p=0.003)

Preoperative blood product

- 28% vs 33% (p=0.72)

Proportion of Patients with Potential for Improvement by Area

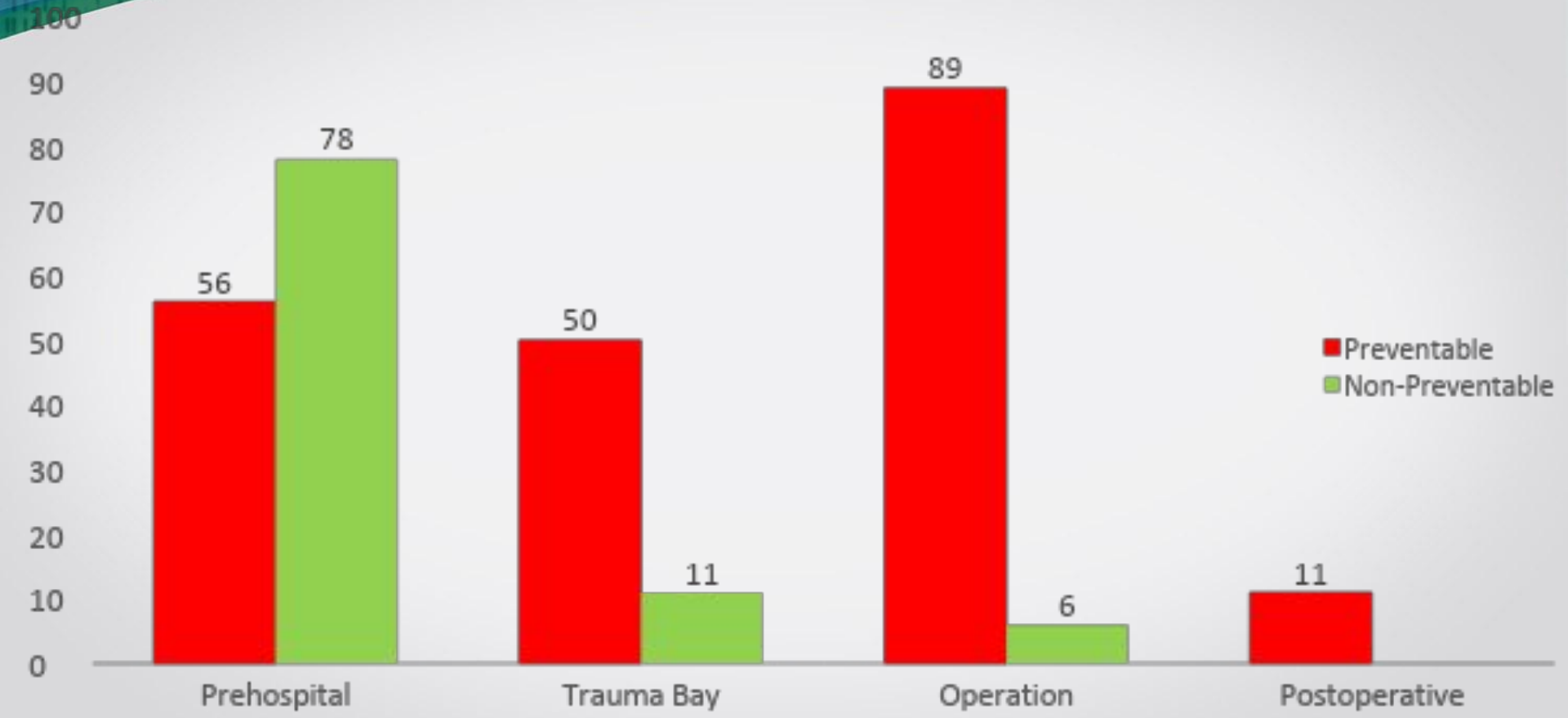


Table 1: Case Characteristics of those Undergoing Emergent Trauma Laparotomy with Potentially Preventable Death Due to Hemorrhage

Case	Mechanism of Injury	Resuscitative Thoracotomy (Time to RT)	ED Time	OR Time	Abdominal Injuries (Significant Non-Abdominal Injury)	Possibly Preventable	Area for Potential Improvement
30	GSW	Yes (5)	14	136	Liver, Stomach, Aorta	Yes	Prehospital, Postoperative
18	GSW	Yes (7)	33	9	Liver	Yes	Prehospital, Trauma Bay
3	GSW	No	15	63	Retroperitoneal Hemorrhage	Yes	Trauma Bay, Operation
6	MCC	No	59	115	Pelvic Fractures	Yes	Trauma Bay, Operation
7	GSW	Yes (38)	30	56	Small bowel, Colon, Possible Iliac Vessel	Yes	Prehospital, Trauma Bay, Operation
14	GSW	Yes (3)	23	196	Liver, Colon, Aorta, IVC	Yes	Prehospital, Trauma Bay, Operation
15	GSW	Yes (8)	21	45	Liver	Yes	Trauma Bay, Operation
16	MCC	No	14	100	Liver, Spleen	Yes	Prehospital, Trauma Bay, Operation
20	Fall	Yes (33)	41	33	Liver	Yes	Prehospital, Trauma Bay, Operation
21	GSW	No	38	137	Liver, Aorta, L renal vein	Yes	Trauma Bay, Operation
1	GSW	No	26	27	Liver	Yes	Prehospital, Operation
2	MVC	No	31	46	Liver, Diaphragm	Yes	Operation
9	MVC	No	11	84	Spleen	Yes	Prehospital, Operation
10	GSW	No	12	73	Liver, Possible Portal Vein	Yes	Operation
11	GSW	No	11	155	Liver	Yes	Prehospital, Operation
13	GSW	No	15	205	Aorta, Pancreas, Possible Portal Vein	Yes	Operation
19	GSW	No	8	131	Liver, IVC	Yes	Prehospital, Operation
17	GSW	No	38	117	Liver	Yes	Operation, Postoperative

Objectives

1. *What is emergent trauma laparotomy and why is it important?*

2. *Outcomes based research on emergent trauma laparotomy*

3. Challenges and future questions for emergent trauma laparotomy

What is an emergent trauma laparotomy???

Definition of ETL

- Laparotomy within 60 minutes of arrival
- Within 90 minutes of arrival
- Within 4 hours of arrival
- Within 6 hours of arrival
- Within 24 hours of arrival

- Physiologic parameters

Definition of ETL

- Once ETL defined:
  - Develop accurate models for risk adjustment
  - Compare institutions
  - Compare individuals

Role of damage control surgery

Prehospital hemorrhage control

Direct peritoneal resuscitation

Role of IR vs OR