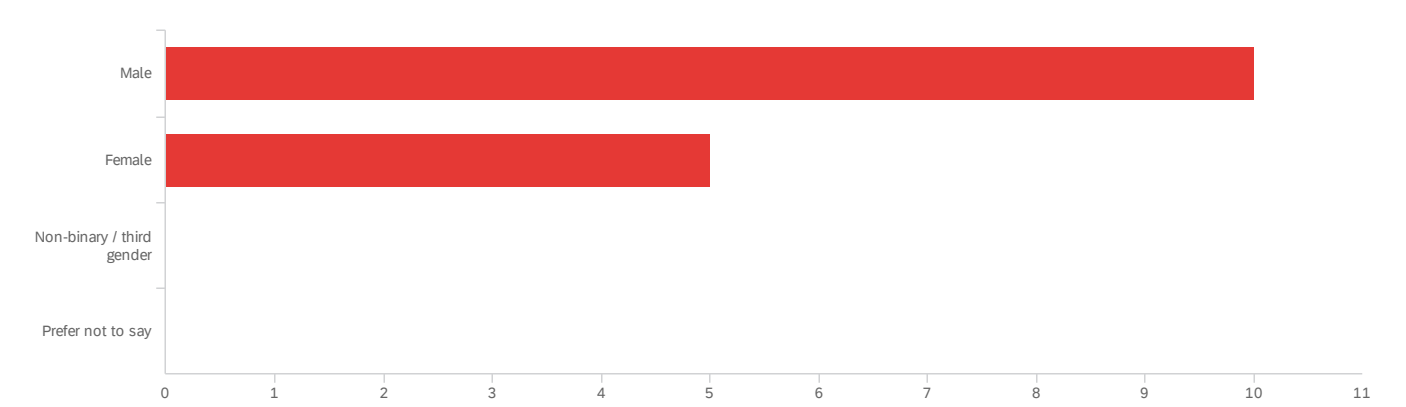


Q1.3 - What is your sex?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is your sex?	1.00	2.00	1.33	0.47	0.22	15

#	Field	Choice Count
1	Male	66.67% 10
2	Female	33.33% 5
3	Non-binary / third gender	0.00% 0
4	Prefer not to say	0.00% 0

15

Showing rows 1 - 5 of 5

Q1.5 - What is your medical specialty?

What is your medical specialty?

Pre-hospital care

Trauma surgery

Paramedic / Prehospital

emergency medicine

Emergency Medicine

Trauma Surgery

Forensic Pathology

Specialist Emergency Physician

General

Family Medicine

Prehospital emergency medical care

Emergency medicine

nephrology

Trauma Surgery

Emergency medicine, critical care

What is your medical specialty?

Pre-hospital care

Trauma surgery

Paramedic / Prehospital

emergency medicine

Emergency Medicine

What is your medical specialty?

Trauma Surgery

Forensic Pathology

Specialist Emergency Physician

General

Family Medicine

Prehospital emergency medical care

Emergency medicine

nephrology

Trauma Surgery

Emergency medicine, critical care

Q1.6 - What is your professional title?

What is your professional title?

Medical Director

Trauma Medical Director

Mr

associate professor

EM Registrar

Prof

Doctor

Dr

Medical Investigator

Medical Specialist: Family Physician

Paramedic

Assoc. Prof. MD

Associate Professor

Fellow, Dr

Physician

Q1.8 - What is your nationality?

What is your nationality?

South African

US

South African

Turkish

Congolese (DRC)

South African

RSA

South African

South African

RSA

South African

Turkey

South African

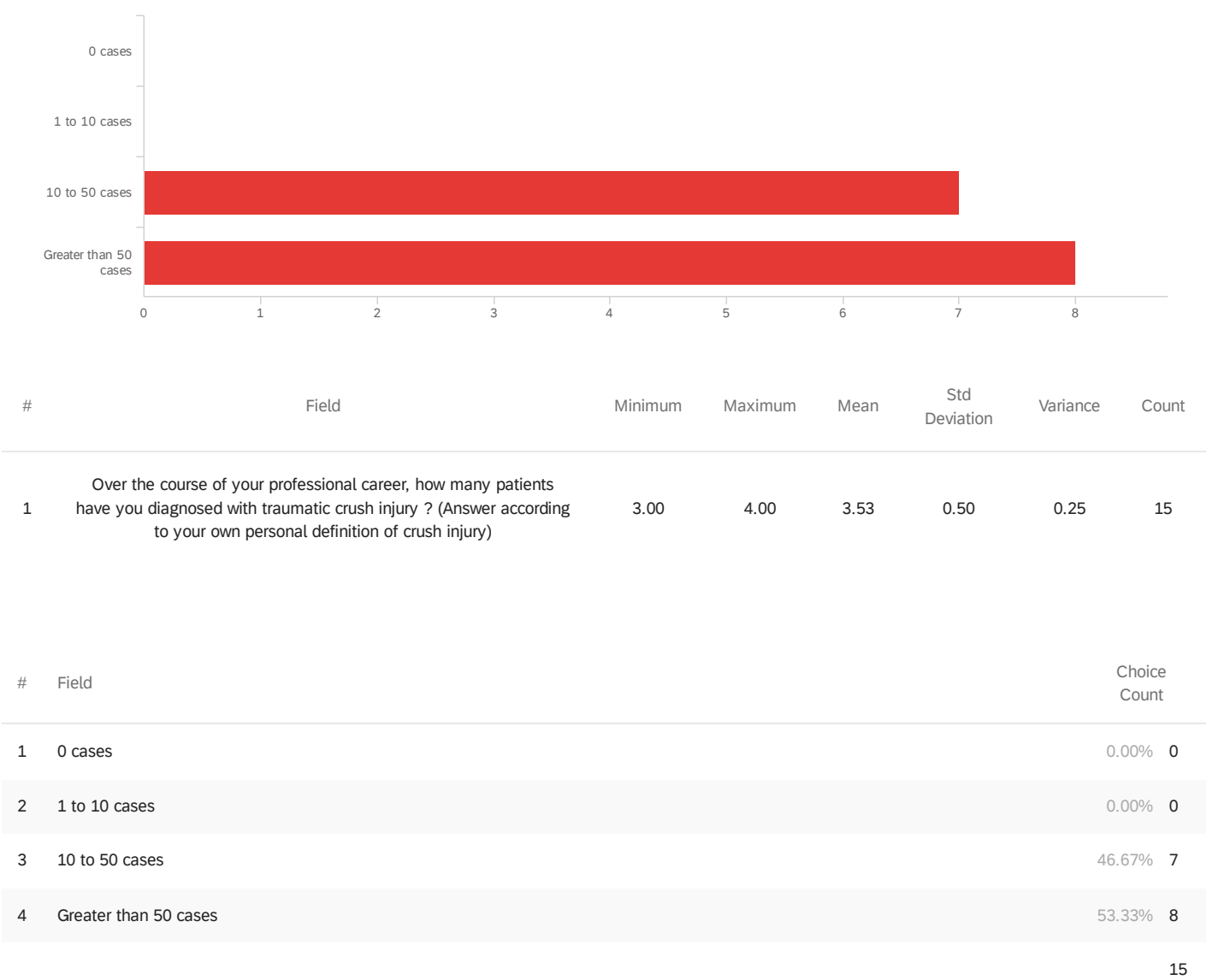
South African

USA

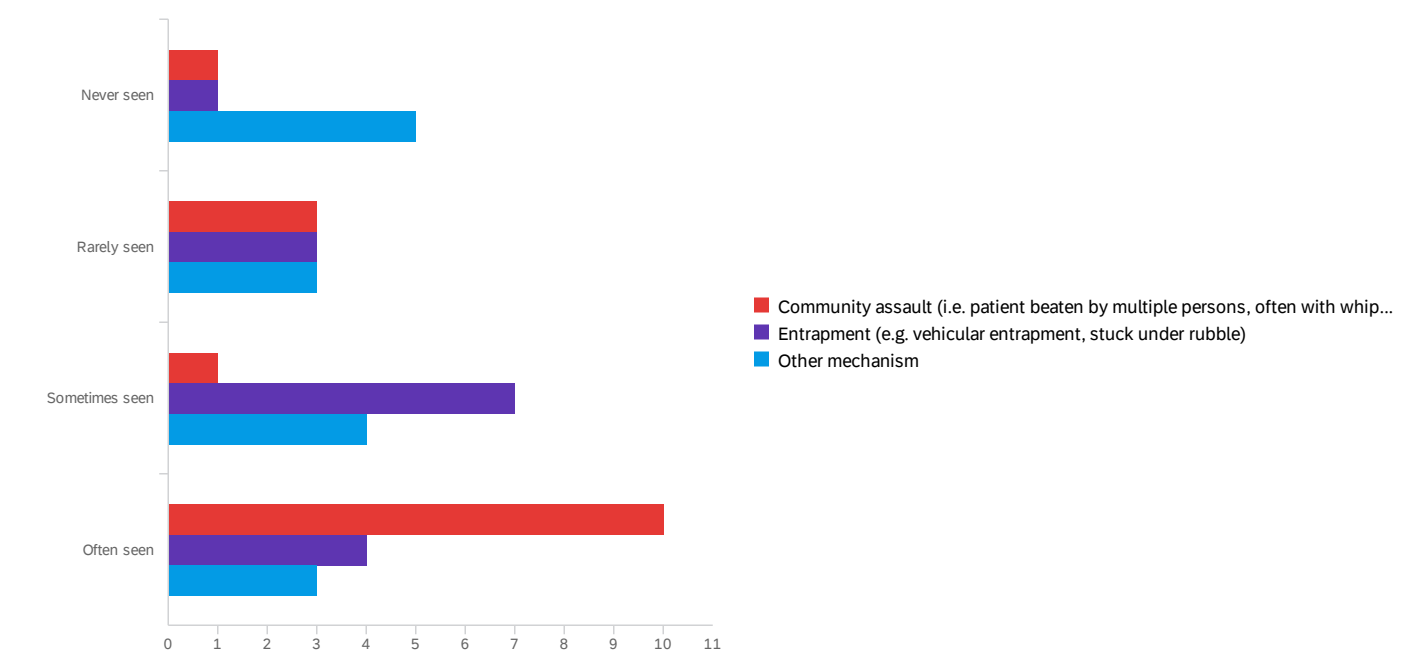
Q1.9 - How many years of clinical experience do you have? (Year 1 would be the first year following graduation from medical school or equivalent).

How many years of clinical experience do you have? (Year 1 would be the fi...								
20								
30								
17								
11								
21								
33								
10								
17								
5								
11								
13								
10								
21								
13								
13								
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count	
1	How many years of clinical experience do you have? (Year 1 would be the first year following graduation from medical school or equivalent).	5.00	33.00	16.33	7.40	54.76	15	

Q2.1 - Over the course of your professional career, how many patients have you diagnosed with traumatic crush injury ? (Answer according to your own personal definition of crush injury)



Q2.2 - Please describe how often the following mechanisms of injury contributed to traumatic crush injury in the patients you have cared for.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Community assault (i.e. patient beaten by multiple persons, often with whips or rods)	1.00	4.00	3.33	1.01	1.02	15
2	Entrapment (e.g. vehicular entrapment, stuck under rubble)	1.00	4.00	2.93	0.85	0.73	15
3	Other mechanism	1.00	4.00	2.33	1.14	1.29	15

#	Field	Never seen		Rarely seen		Sometimes seen		Often seen		Total
1	Community assault (i.e. patient beaten by multiple persons, often with whips or rods)	6.67%	1	20.00%	3	6.67%	1	66.67%	10	15
2	Entrapment (e.g. vehicular entrapment, stuck under rubble)	6.67%	1	20.00%	3	46.67%	7	26.67%	4	15
3	Other mechanism	33.33%	5	20.00%	3	26.67%	4	20.00%	3	15

Showing rows 1 - 3 of 3

Q2.3 - Please elaborate on other mechanisms of injury that contributed to traumatic crush injury that you have treated.

Please elaborate on other mechanisms of injury that contributed to traumati...

None

Blast injury, Found down

N/A

N/A

road traffic accidents

Blunt polytrauma due to vehicle trauma

N/A

Thermal and electrical burns

Not applicable

pedestrian vehicle accidents, heavy equipment injury

Burns and electrical injuries

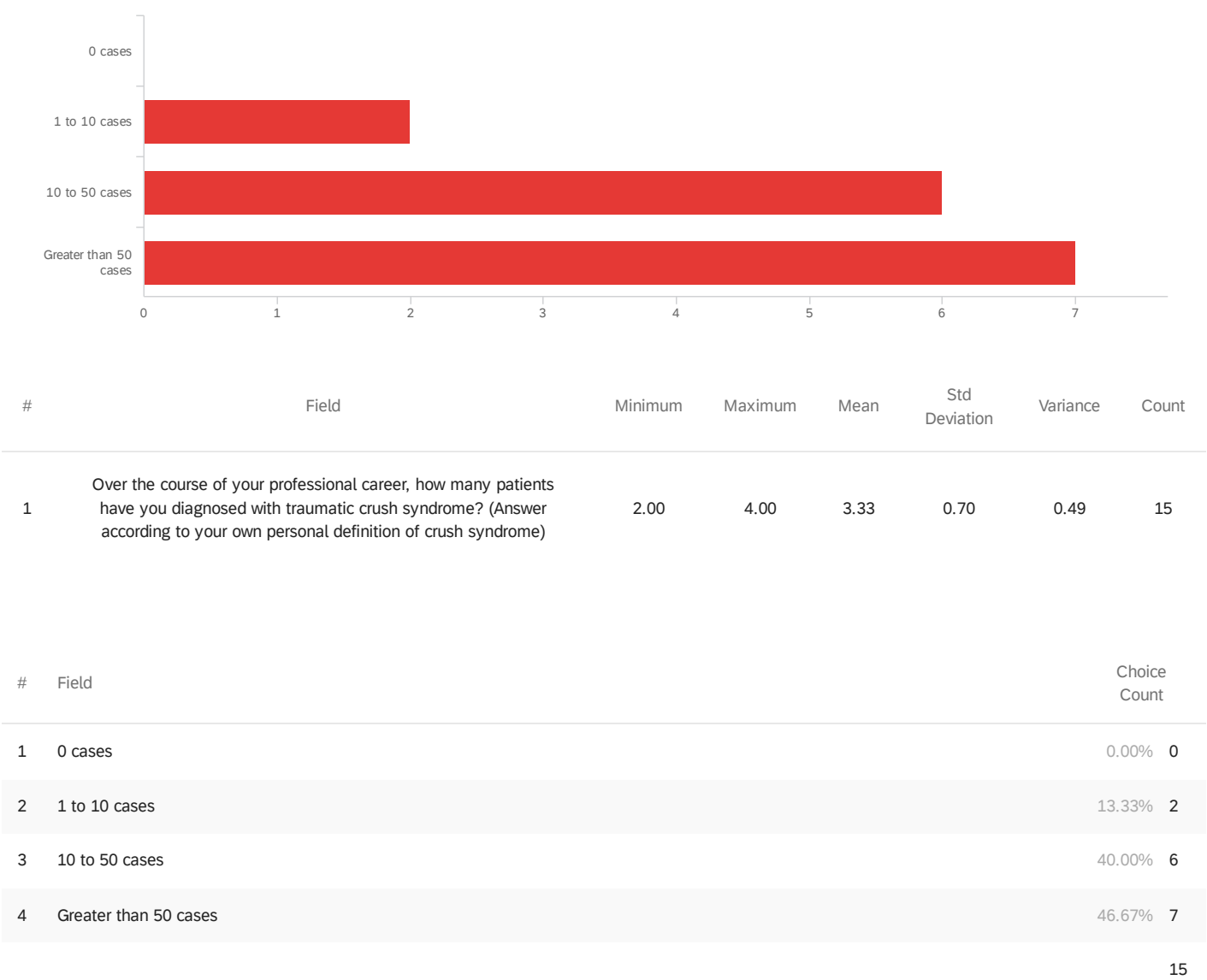
disasters, especially earthquakes and building collapses

phlegmasia cerulea dolens in an alcoholic.

burns, compartment syndrome, reperfusion injury

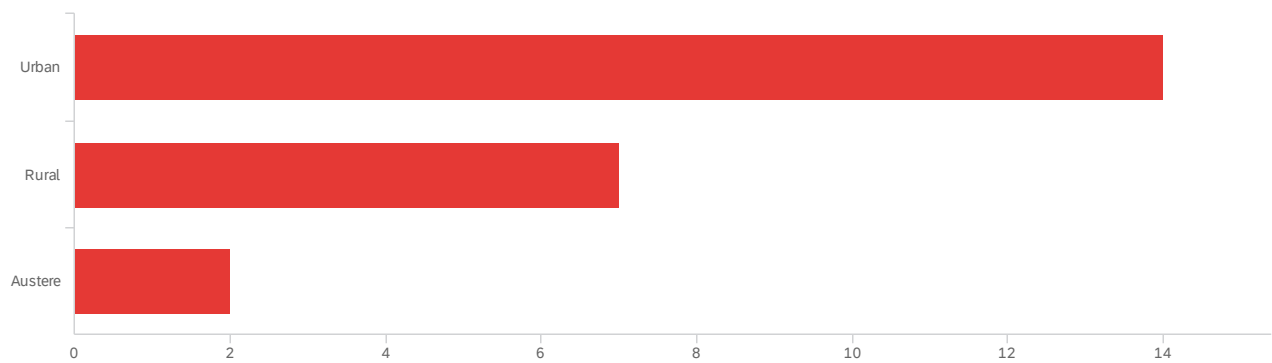
Military injuries

Q2.4 - Over the course of your professional career, how many patients have you diagnosed with traumatic crush syndrome? (Answer according to your own personal definition of crush syndrome)



15

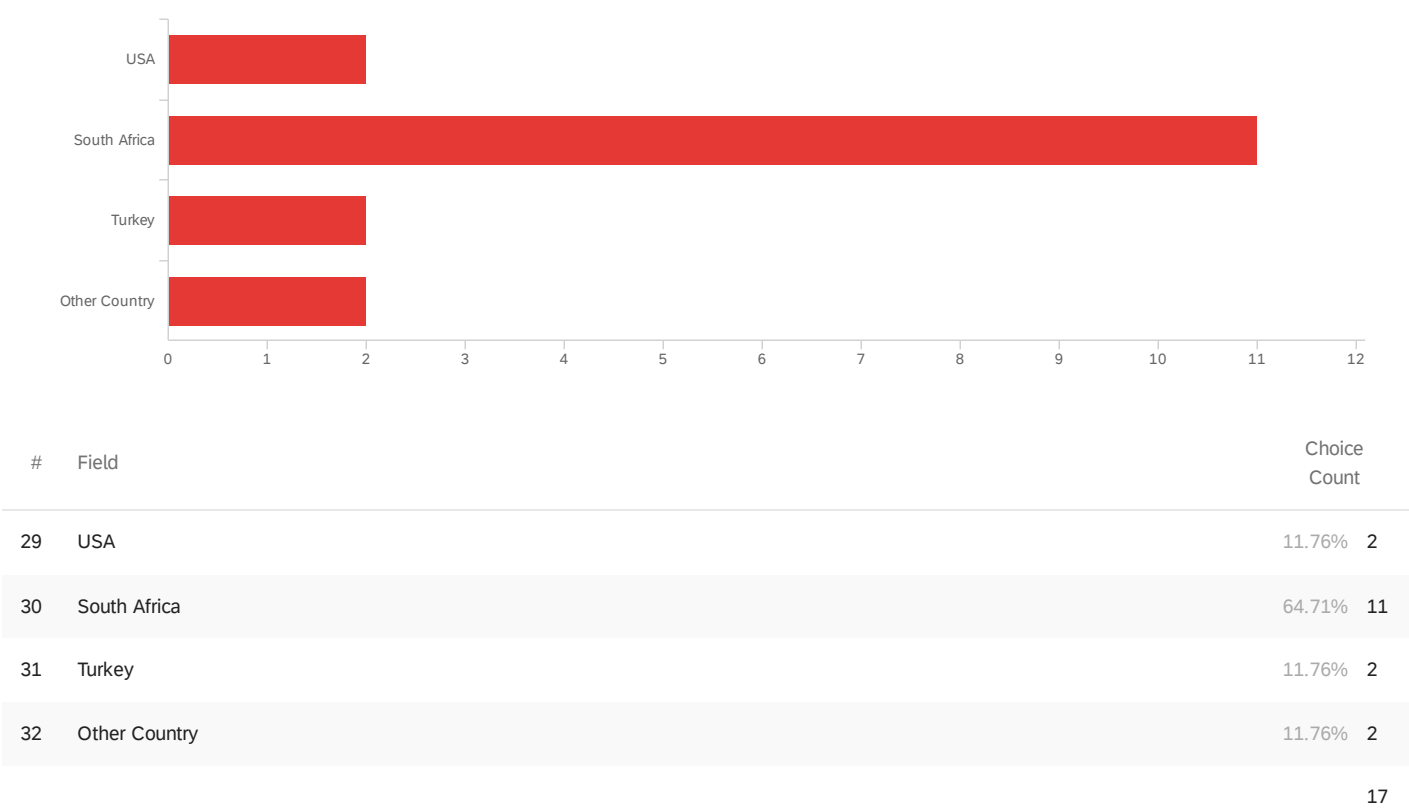
Q2.5.1 - Please describe the geographies in which you have cared for patients with crush syndrome over the course of your career. Please check all that apply.



#	Field	Choice Count
26	Urban	60.87% 14
27	Rural	30.43% 7
28	Austere	8.70% 2
		23

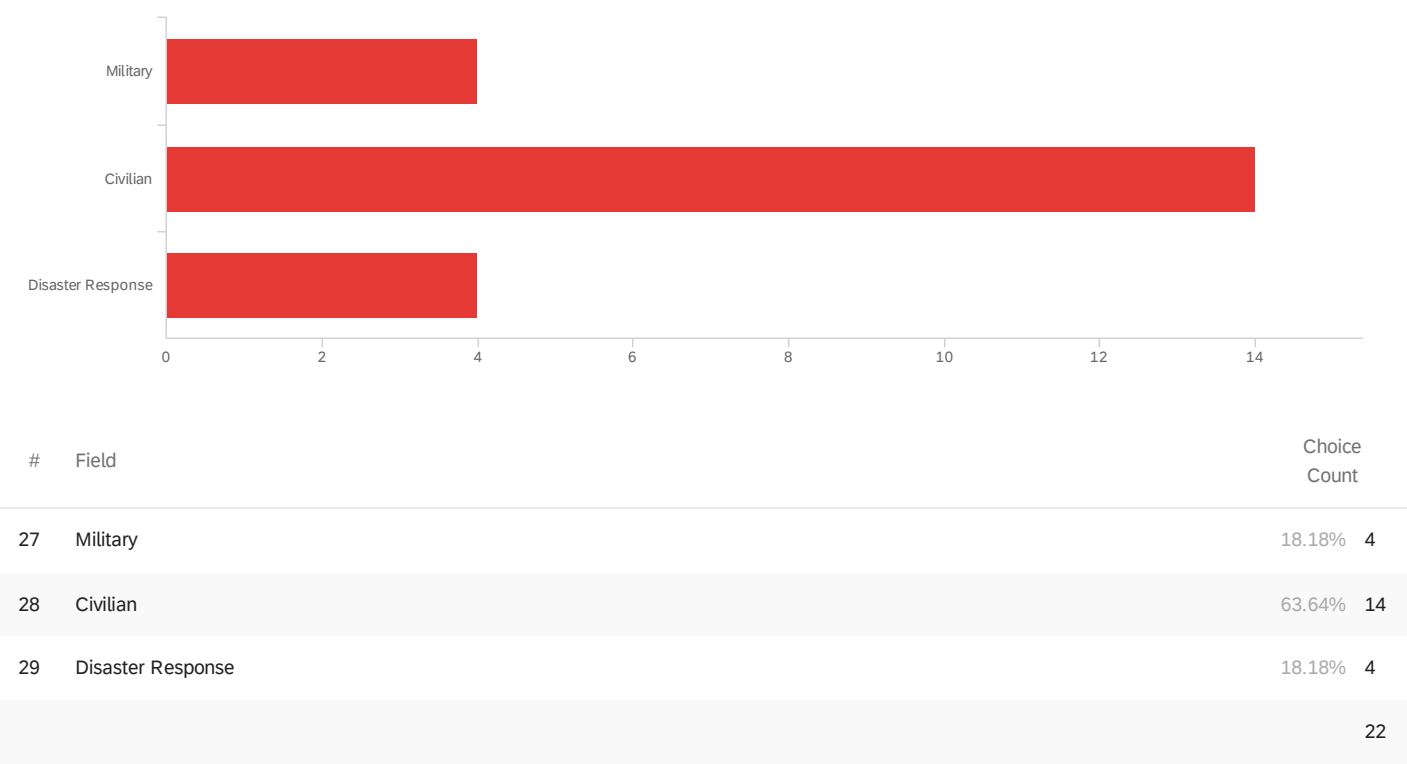
Showing rows 1 - 4 of 4

Q2.5.2 - Please describe the countries in which you have cared for patients with crush syndrome over the course of your career. Please check all that apply.



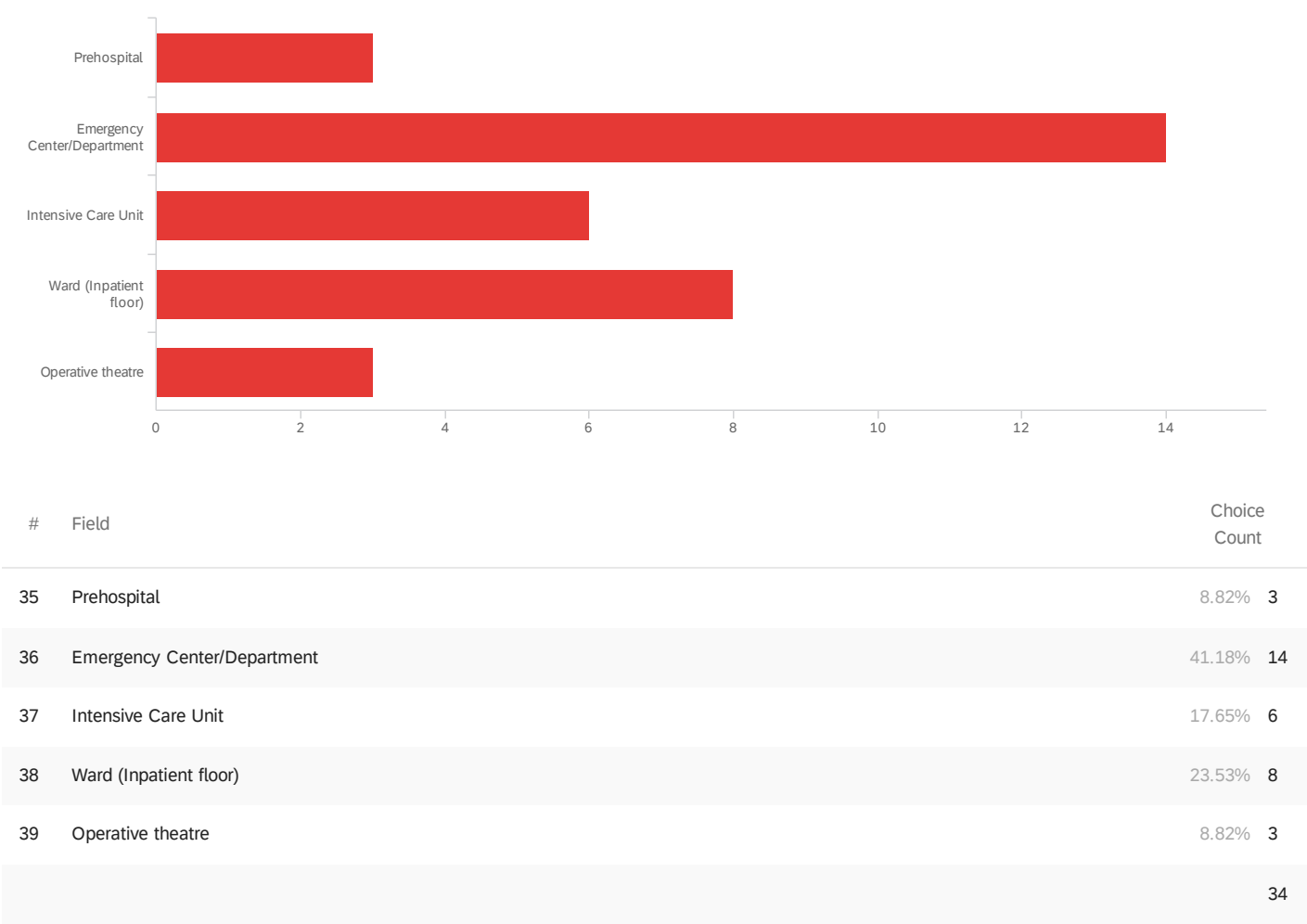
Showing rows 1 - 5 of 5

Q2.5.3 - Please describe the clinical environment(s) in which you have cared for patients with crush syndrome over the course of your career. Please check all that apply.



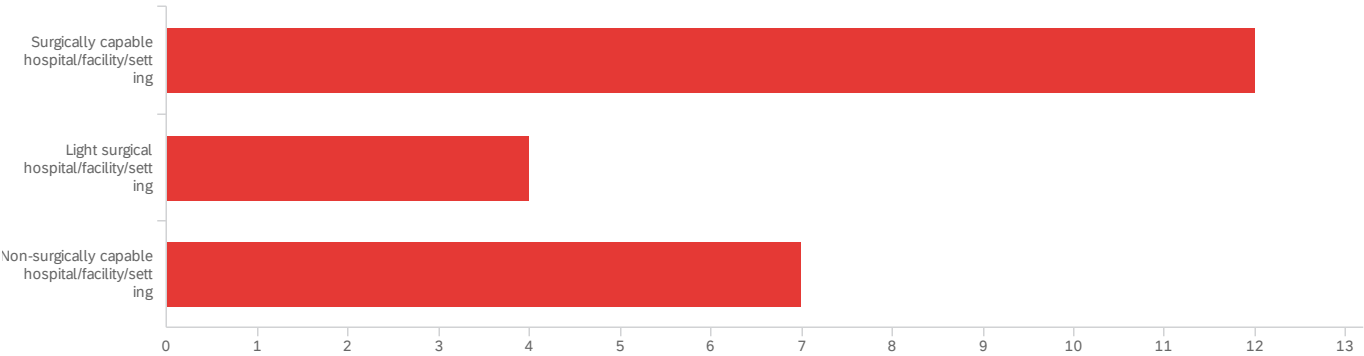
Showing rows 1 - 4 of 4

Q2.5.4 - Please describe the clinical location(s) in which you have cared for patients with crush syndrome over the course of your career. Please check all that apply.



Showing rows 1 - 6 of 6

Q2.5.5 - Please describe the the facility type(s) in which you cared for patients with crush syndrome over the course of your career. Please check all that apply



#	Field	Choice Count
15	Surgically capable hospital/facility/setting	52.17% 12
16	Light surgical hospital/facility/setting	17.39% 4
17	Non-surgically capable hospital/facility/setting	30.43% 7
		23

Showing rows 1 - 4 of 4

Q2.6 - In a few sentences, please provide more context about the clinical environment(s) in which you have cared for patients with crush syndrome over the course of your career.

In a few sentences, please provide more context about the clinical environm...

As a pre-hospital physician we often treated the patients on scene in the immediate aftermath. Also during my time in the Emergency Centre and during response to the Haitian earthquake in 2010

Deployed military role 3 Civilian level 1 trauma centers

Mostly prehospital, urban or peri-urban setting with relatively close proximity to healthcare.

Immediately after the great Turkey-Syria earthquake, I worked voluntarily in the field hospital established in Hatay province. We treated many crush syndrome patients there. However, our duty there was to stabilize the patients and ensure their transfer to better equipped hospitals.

i have cared for patients with crush syndrome in in level one hospital following a community assault or a road traffic accident, that required transfer to tertiary or level 2 institutions because of lack of high care and lack of surgical capability and also in level 3 institutions(academic) with surgical capabilities.

Mostly large urban hospitals in South Africa with busy trauma centers and fully capable surgical facilities including peri-operative and ICU support, with hemodialysis availability.

Tygerberg Hospital (Tertiary Hospital) Trauma Unit and Trauma Surgery Unit: Admitted, assessed, diagnosed, and medically treated patients with crush syndrome.

After internship and community service and pre-EM training, I worked as a medical officer in surgery where we cared for patients with crush syndrome as inpatients (ward/high care) During my EM residency I rotated through various Emergency Departments and specialised trauma units in the Cape Town Metropole where the trauma burden is high and community assaults, interpersonal violence/assault, MVAs, burns are a common occurrence. I also attended to patients in the ICU (general ICU and Burns ICU) during my residency where we treated patients with severe complicated crush syndrome As a consultant at Khayelitsha - multiple patients with crush syndrome secondary to community assaults, blunt force trauma, burns, MVA- From uncomplicated (i.e no acid-base disturbances/anuria/electrolyte abnormalities/renal failure) to severe complicated crush syndrome (acidotic, electrolyte imbalances, anuria, pulmonary oedema, confusion) requiring more advanced emergency care (acute dialysis, ventilatory support) which required referral to higher level of care (ICU, dialysis etc)

The care setting was a rural secondary hospital with an EC, theatre, surgical department and a high-care unit. Moderate resources were available, but due to resource restrictions, investigation for possible crush injury/syndrome was limited. Crush syndrome patients were admitted to an overnight facility in the ED to monitor for resolution of haematuria and improvement in urine output and creatinine. If no downward trend was noted over 24 hours or a parameter deterioration, admission to surgical inpatients was made. On one occasion, a highcare admission and on multiple occasions onward referral to a tertiary setting capable of managing polytrauma patients (no after-hours CT at facility nor enough resources to manage true polytrauma)

Managed patients in a secondary level hospital, limited surgical capable, in the north west province of RSA in the general EC as well as during admission to a surgical ward. Management of patients in the general EC of a rural district hospital in the western cape province of SA, no high care or ICU, only minor procedure capable setting.

Majority of the instances have been in the out of hospital setting. Military depolyments and/ or as a member of EMS managed a range of emergencies.

I am currently working in a tertiary hospital, so it has a capacity equivalent to trauma centers compared to world standards. But I have also served in military outposts in disasters and border regions in my country. I have also served in field hospitals with lower capacity, especially in disasters.

In a few sentences, please provide more context about the clinical environm...

Most of the patients that I have cared for with crush syndrome were in the trauma units, resuscitation unit and surgical ICU and wards at tertiary level.

small & large hospitals, with basic services readily available

I have seen in a limited number of times in the deployed, combat setting. Most of my experiences with it have been at a level 1 trauma center.

Q2.7 - In a few sentences, please provide more context about the clinical environment(s) in which you currently practice.

In a few sentences, please provide more context about the clinical environm...

Pre-hospital context - but with very limited in-field clinical exposure as the role is mostly managerial

Military to include partnership with civilian level 2 trauma center in local area

Same as above

The hospital I currently work at is a tertiary training and research hospital. All kinds of surgical and non-surgical treatments can be applied in this hospital.

i am currently in a tertiary institution (Groote Schuur Hospital) who has trauma surgeons, high care units, ICU and renal replacement treatment services.

Large busy urban hospital with busy trauma center, full surgical and peri-operative facilities and hemodialysis availability.

Forensic Pathology Services: Medico-legal death investigations including performing autopsy examinations on individuals who have died from other than natural causes.

Consultant/Specialist Emergency Physician at TBH trauma: multiple patients with crush syndrome secondary to community assaults, blunt force trauma, burns, MVA From uncomplicated (i.e no acid-base disturbances/anuria/electrolyte abnormalities/renal failure) to severe complicated crush syndrome (acidotic, electrolyte imbalances, anuria, pulmonary oedema, confusion) requiring more advanced emergency care (acute dialysis, ventilatory support)

Except for the odd EC-locum shift, I am currently practicing as a medical investigator in a research environment: TB clinical trials.

Rural district hospital in the western cape of SA. Limited staff and resource setting. Trauma patients seen in a general EC. X-ray imaging available with no advanced imaging, currently no POCUS available, No ICU or high care facilities. Theatre available for minor trauma related procedures only- formalization of traumatic digit amputations, minor wound debridement etc. Most trauma related procedures done are front room procedures. Mostly 1 doctor available in EC during after hour periods.

Currently practising in the prehospital milieu. The out of hospital setting, is dynamic, in that we are called upon to manage medical and trauma emergencies within various situations. The prehospital trauma burden managed in the Western Cape of South Africa does not facsimile those descibed in other LMICs. The large trauma volumes, unprecedented types of trauma and sheer injuires seen in our setting offer exposure to a multitude of injuries and patient conditions.

2.6

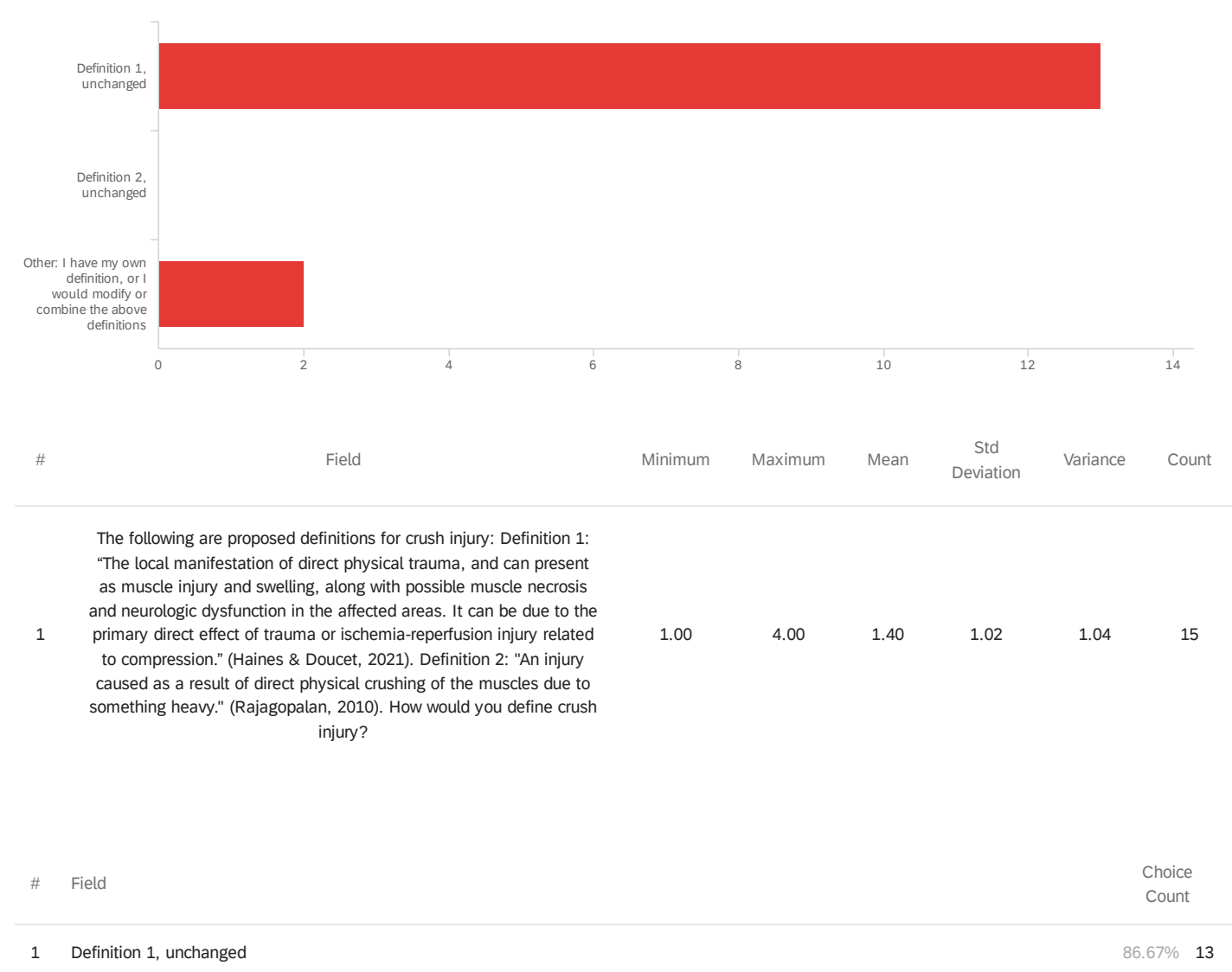
Same as for Q2.6.

tertiary academic hospital with all services available

I currently work in a large academic, level 1 trauma center.

Q3 - The following are proposed definitions for crush injury: Definition 1: “The local manifestation of direct physical trauma, and can present as muscle injury and swelling, along with possible muscle necrosis and neurologic dysfunction in the affected areas. It can be due to the primary direct effect of trauma or ischemia-reperfusion injury related to compression.” (Haines & Doucet, 2021). Definition 2: "An injury caused as a result of direct physical crushing of the muscles due to something heavy." (Rajagopalan, 2010).

How would you define crush injury?



#	Field	Choice Count
2	Definition 2, unchanged	0.00% 0
4	Other: I have my own definition, or I would modify or combine the above definitions	13.33% 2
		15

Showing rows 1 - 4 of 4

Q3.1 - Please provide your definition of crush injury and explain why you prefer this definition over other options.

Please provide your definition of crush injury and explain why you prefer t...

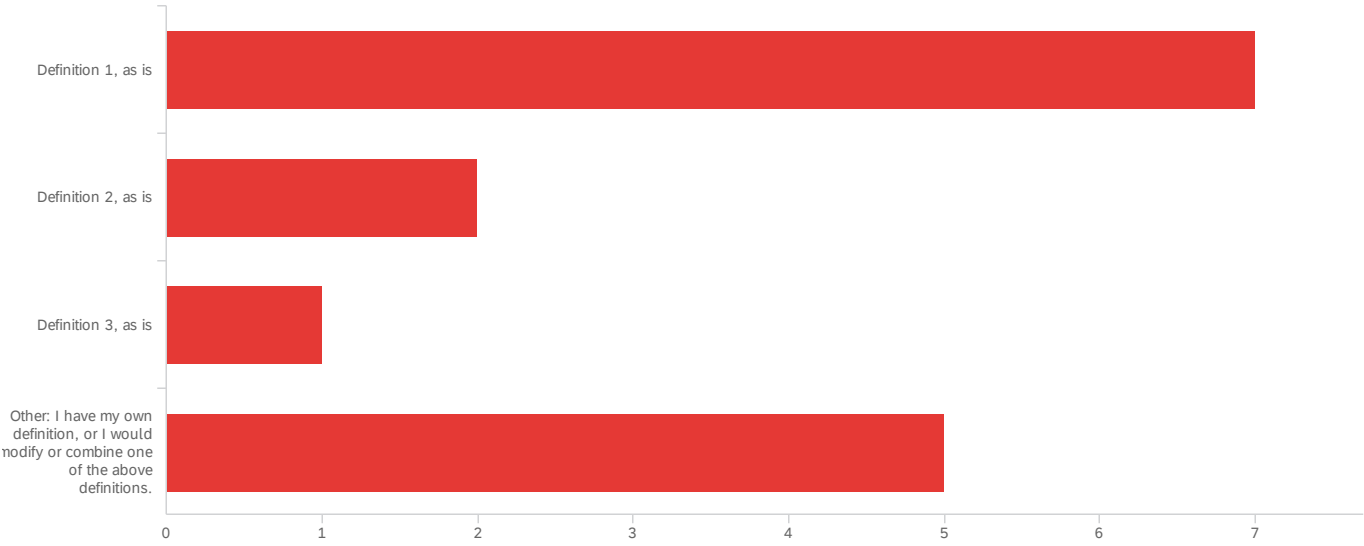
An injury caused either by blows to the body (e.g. during whipping) or by muscles being crushed under a heavy weight (e.g. following building collapse), leading to muscular damage and release of myoglobin from myocytes. (Both mechanisms are important; one is assault, the other is misadventure.)

The local manifestation of direct physical trauma, and can present as muscle injury and swelling, along with possible muscle necrosis and neurologic dysfunction in the affected areas; however, the absence of these clinical features should not dissuade the clinician if there remains a high index of suspicion. It can be due to the primary direct effect of trauma or ischemia-reperfusion injury related to compression.

Q4 - The following are proposed definitions for crush syndrome: Definition 1: "The systemic manifestation of crush injury, which can result in acute kidney injury, multisystem organ injury or death." (Haines & Doucet, 2021). Definition 2: "A series of metabolic changes produced due to an injury of the skeletal muscles of such a severity as to cause a disruption of cellular integrity and release of its contents into the circulation." (Rajagopalan, 2010). Definition 3: "An injury in which patients suffer from extensive muscle damage, leading to devastating sequelae of hemodynamic and metabolic disturbances and, most of all, acute renal failure." (Jun et al, 1997). How would you define crush syndrome?

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	The following are proposed definitions for crush syndrome: Definition 1: "The systemic manifestation of crush injury, which can result in acute kidney injury, multisystem organ injury or death." (Haines & Doucet, 2021). Definition 2: "A series of metabolic changes produced due to an injury of the skeletal muscles of such a severity as to cause a disruption of cellular integrity and release of its contents into the circulation." (Rajagopalan, 2010). Definition 3: "An injury in which patients suffer from extensive muscle damage, leading to devastating sequelae of hemodynamic and metabolic disturbances and, most of all, acute renal failure." (Jun et al, 1997). How would you define crush syndrome?	1.00	4.00	2.27	1.34	1.80	15

#	Field	Choice Count
1	Definition 1, as is	46.67% 7
2	Definition 2, as is	13.33% 2
3	Definition 3, as is	6.67% 1
4	Other: I have my own definition, or I would modify or combine one of the above definitions.	33.33% 5



Q4.1 - Please provide your definition of crush syndrome and explain why you prefer this definition over the other options.

Please provide your definition of crush syndrome and explain why you prefer...

I support definition 1 as is; however, it is important to note that "Crush Syndrome" is an example of AEROBIC MYORENAL SYNDROME. The other type being ANAEROBIC MYORENAL SYNDROME which is an ischaemia-reperfusion phenomenon which follows in a limb which has been ischemic and is then reperfused (e.g. when a tourniquet has been on a leg for several hours and is then released or a leg which has been entrapped under building rubble for several hours and then freed.)

Combine 1 and 2 and 3 The systemic response of extensive skeletal muscle damage of such severity manifested by haemodynamic and metabolic sequelae from the disruption of cellular integrity and release of its contents into the circulation, which can result in acute kidney injury, multisystem organ injury or death

The systemic manifestation of crush injury, resulting in haemodynamic and metabolic disturbance often accompanied by acute kidney injury, but may progress to multisystem organ dysfunction or death.

Combination of Def 2 and 3 is a more complete description of crush syndrome.

An injury in which patients suffer from extensive muscle damage, leading to devastating sequelae of hemodynamic and metabolic disturbances and, most of all, acute kidney injury.

Q5 - The following are proposed definitions for acute kidney injury: Definition1: KDIGO

The Kidney Disease: Improving Global Outcomes Guideline (KDIGO) defines AKI as:

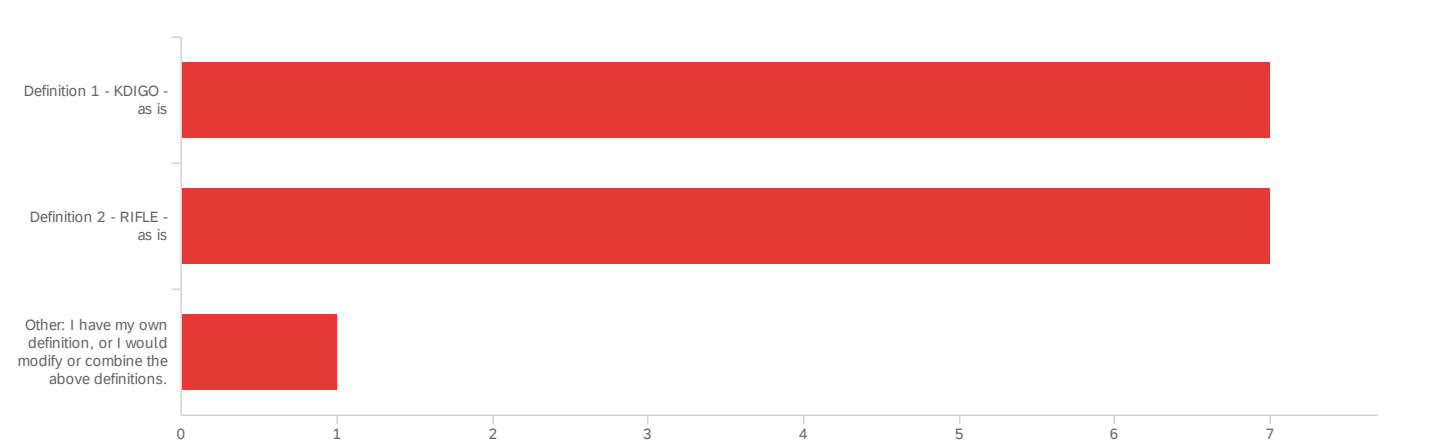
Increase in serum creatinine by ≥ 0.3 mg/dL (≥ 26.5 micromol/L) within 48 hours OR

Increase in serum creatinine to ≥ 1.5 times baseline within 7 days OR Urine output

Definition 2: RIFLE The Acute Dialysis Quality Initiative RIFLE criteria defines AKI as:

Increase in serum creatinine ≥ 1.5 times baseline within 48 hours OR Decrease in GFR

$\geq 25\%$ within 48 hours OR Urine output How would you define acute kidney injury?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	The following are proposed definitions for acute kidney injury: Definition1: KDIGO The Kidney Disease: Improving Global Outcomes Guideline (KDIGO) defines AKI as: Increase in serum creatinine by ≥ 0.3 mg/dL (≥ 26.5 micromol/L) within 48 hours OR Increase in serum creatinine to ≥ 1.5 times baseline within 7 days OR Urine output Definition 2: RIFLE The Acute Dialysis Quality Initiative RIFLE criteria defines AKI as: Increase in serum creatinine ≥ 1.5 times baseline within 48 hours OR Decrease in GFR $\geq 25\%$ within 48 hours OR Urine output How would you define acute kidney injury?	1.00	3.00	1.60	0.61	0.37	15

#	Field	Choice Count
1	Definition 1 - KDIGO - as is	46.67% 7

#	Field	Choice Count
2	Definition 2 - RIFLE - as is	46.67% 7
3	Other: I have my own definition, or I would modify or combine the above definitions.	6.67% 1
		15

Showing rows 1 - 4 of 4

Q5.1 - Please provide your definition of acute kidney injury, and explain why you prefer this definition over the other options.

Please provide your definition of acute kidney injury, and explain why you...

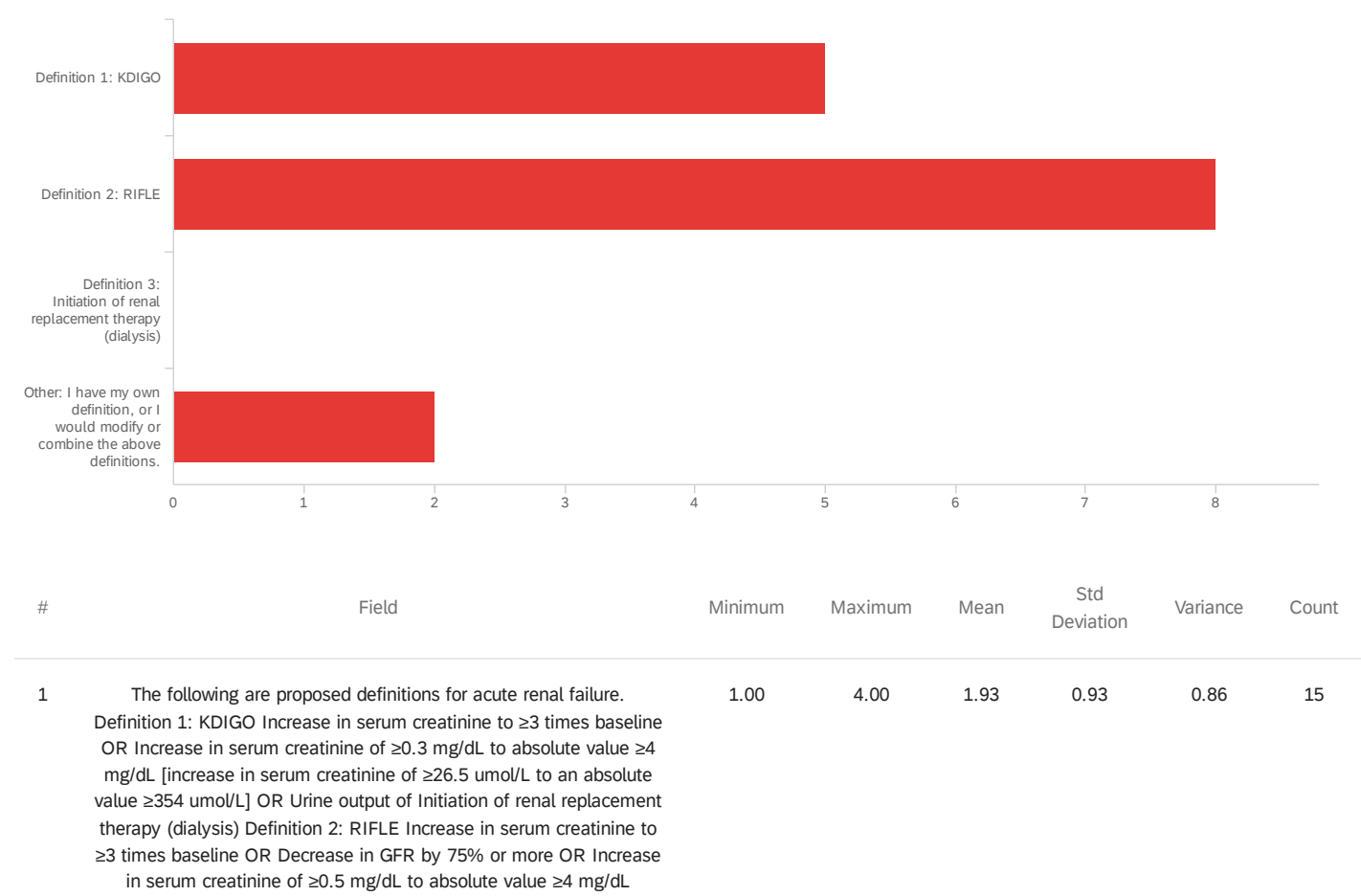
Increase in serum creatinine by ≥ 0.3 mg/dL (≥ 26.5 micromol/L) within 48 hours OR Increase in serum creatinine to ≥ 1.5 times baseline within 7 days
OR Urine output < 0.5 mL/kg/hr for ≥ 6 h (despite adequate fluid intake/fluid resuscitation) I see the value in having both an absolute increase in creatinine and a 1.5x factor increase in the criteria, that captures both the acute spike and prolonged nature and sometimes delayed development with the 48 hours and and 7 days timespan. eGFR in the setting I worked in isn't reliable unless manually calculated so I tend not to place much stock in it. Urine output that remains low despite adequate fluid in my opinion is more of a concern than just a low urine output (as no baseline is known)

Q6 - The following are proposed definitions for acute renal failure. Definition 1: KDIGO

Increase in serum creatinine to ≥ 3 times baseline OR Increase in serum creatinine of ≥ 0.3 mg/dL to absolute value ≥ 4 mg/dL [increase in serum creatinine of ≥ 26.5 μ mol/L to an absolute value ≥ 354 μ mol/L] OR Urine output of Initiation of renal replacement therapy (dialysis) Definition 2: RIFLE Increase in serum creatinine to ≥ 3 times baseline OR

Decrease in GFR by 75% or more OR Increase in serum creatinine of ≥ 0.5 mg/dL to absolute value ≥ 4 mg/dL [increase in serum creatinine of ≥ 44 μ mol/L to an absolute value ≥ 354 μ mol/L] OR Urine output Initiation of renal replacement therapy (dialysis) Definition

3: Initiation of renal replacement therapy. How would you define acute renal failure?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
	[increase in serum creatinine of ≥ 44 $\mu\text{mol/L}$ to an absolute value ≥ 354 $\mu\text{mol/L}$] OR Urine output Initiation of renal replacement therapy (dialysis) Definition 3: Initiation of renal replacement therapy. How would you define acute renal failure?						

#	Field	Choice Count
1	Definition 1: KDIGO	33.33% 5
2	Definition 2: RIFLE	53.33% 8
3	Definition 3: Initiation of renal replacement therapy (dialysis)	0.00% 0
4	Other: I have my own definition, or I would modify or combine the above definitions.	13.33% 2

15

Showing rows 1 - 5 of 5

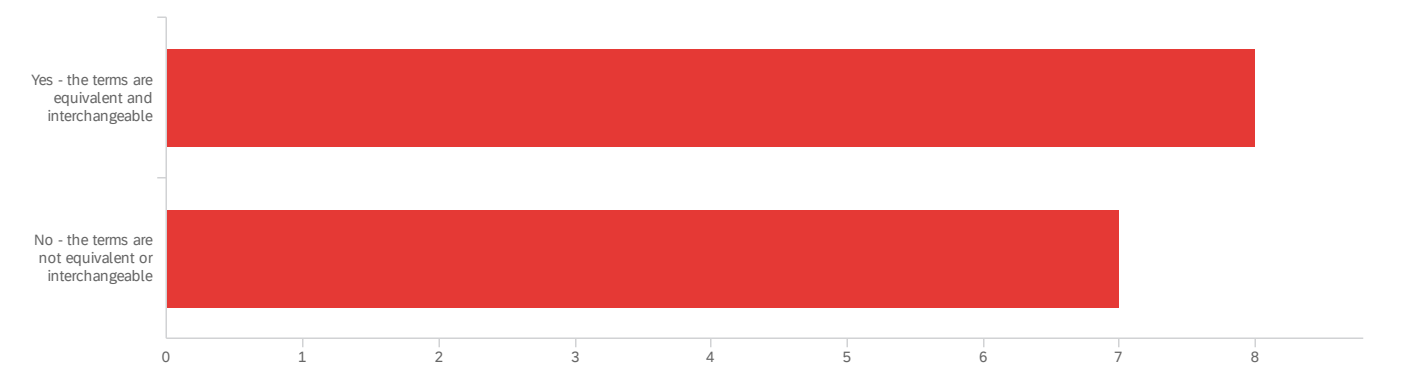
Q6.1 - Please provide your definition of acute renal failure, and explain why you prefer this definition over the other options.

Please provide your definition of acute renal failure, and explain why you...

Increase in serum creatinine to ≥ 3 times baseline OR Increase in serum creatinine of ≥ 0.5 mg/dL to absolute value ≥ 4 mg/dL [increase in serum creatinine of ≥ 44 $\mu\text{mol/L}$ to an absolute value ≥ 354 $\mu\text{mol/L}$] OR Urine output < 0.3 mL/kg/hour for ≥ 24 hours or anuria for ≥ 12 hours (despite adequate volume intake/fluid resuscitation) OR Initiation of renal replacement therapy (dialysis). As for AKI definition above, GFR is often unreliable unless calculated manually and Urine output that remains low despite adequate fluid in my opinion is more of a concern than just a low urine output (as no baseline is known)

As a nephrologist, the term "acute renal failure" is no longer used, instead "acute kidney injury" is now preferred.

Q7 - Do you consider the terms crush syndrome and traumatic rhabdomyolysis to be equivalent and interchangeable?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you consider the terms crush syndrome and traumatic rhabdomyolysis to be equivalent and interchangeable?	1.00	2.00	1.47	0.50	0.25	15

#	Field	Choice Count
1	Yes - the terms are equivalent and interchangeable	53.33% 8
2	No - the terms are not equivalent or interchangeable	46.67% 7

15

Showing rows 1 - 3 of 3

Q7.1 - Please explain the relationship between crush syndrome and traumatic rhabdomyolysis. How do these two diagnoses differ from one another?

Please explain the relationship between crush syndrome and traumatic rhabdo...

I am not sure that traumatic rhabdomyolysis adequately describes the multi systemic and severity of the condition

Crush syndrome and traumatic rhabdomyolysis are closely related medical conditions that both involve muscle damage, but they have distinct characteristics and implications. While both conditions share the fundamental issue of muscle damage and myoglobin release into the bloodstream, crush syndrome is a more severe form with additional systemic complications and typically arises from prolonged crush injuries.

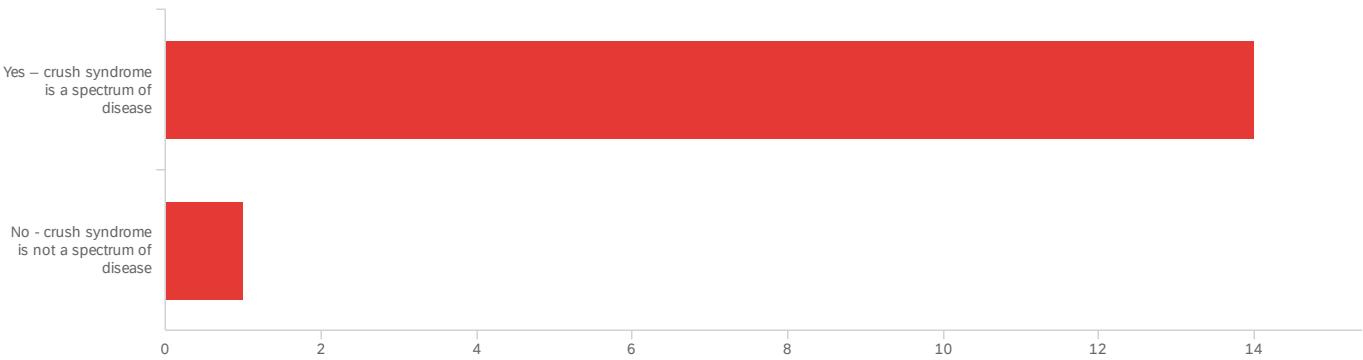
traumatic rhabdomyolysis is a direct injury from crush and crush syndrome is the systemic manifestation resulting from a crush injury caused by skeletal muscle contents into the circulation

In my opinion traumatic rhabdomyolysis is an umbrella term that would include crush syndrome. Crush syndrome, in some definitions and teaching commonly refers to a prolonged crushing of muscles common in the setting of entrapment and subsequent reperfusion. Crush syndrome does not adequately capture other mechanisms of injury like community assault as it wouldn't typically be referred to as 'crush'. Traumatic rhabdomyolysis on the other hand is broader and both entrapment-type injuries as well as community assault injuries seem to fit.

Traumatic rhabdomyolysis can be defined as the onset of an event, but the clinical outcome should not be defined as crush syndrome. If a traumatic rhabdomyolysis does not have a systemic effect on the casualty, which it may not, it may be incorrect to call it a crush syndrome. Traumatic rhabdomyolysis may perhaps be called crush injury. This can also be confused with crush injury which is a type of trauma.

rhabdo is a clinical entity that MAY lead to crush syndrome if untreated

Q8 - Do you consider crush syndrome to be a spectrum of disease?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you consider crush syndrome to be a spectrum of disease?	1.00	2.00	1.07	0.25	0.06	15

#	Field	Choice Count
1	Yes – crush syndrome is a spectrum of disease	93.33% 14
2	No - crush syndrome is not a spectrum of disease	6.67% 1

15

Showing rows 1 - 3 of 3

Q8.1 - Please describe how you would further classify the spectrum of crush syndrome (eg. mild/moderate/severe). Please provide definitions for each subcategory of your choosing.

Please describe how you would further classify the spectrum of crush syndro...

not within my expertise

Mild: requires hydration and monitoring only, spontaneously resolves Moderate: Requires life-sustaining interventions such as CRRT, ventilatory support, etc. Surgical treatment limited to fasciotomy. Severe: in addition to above interventions, requires aggressive surgical intervention such as extensive debridement or amputation.

mild: AKI has begun, but can be kept under control with IV hydration. moderate: the need for renal replacement therapy severe: in addition to the need for renal replacement therapy, the need for multisystemic treatment such as internal organ damage, lung contusion, and the need for mechanical ventilation

1. Mild: metabolic acidosis CK < 3000, normal creatinine, metabolic acidosis resolved after IV fluid management 2. Moderate: metabolic acidosis, CK between 3000 and 5000, renal impairment. Metabolic acidosis and renal impairment resolved after IV fluid management. 3. Severe: Metabolic acidosis, CK> 5000, worsening renal failure requiring dialysis

Mild - venous bicarbonate >22 mmol/L Moderate - venous bicarbonate 18-22 mmol/L Severe venous bicarbonate < 18 mmol/L References: 1. Muckart DJ, Moodley M, Naidu AG, Reddy AD, Meineke KR. Prediction of acute renal failure following soft-tissue injury using the venous bicarbonate concentration. J Trauma. 1992;33(6):813-7. doi: 10.1097/00005373-199212000-00003. 2. Skinner DL, Laing GL, Bruce J, Biccard B, Muckart DJJ. Validating the utilisation of venous bicarbonate as a predictor of acute kidney injury in crush syndrome from sjambok injuries. S Afr Med J. 2017;107(5):446-450. doi: 10.7196/SAMJ.2017.v107i5.12213.

None

Mild: no renal function impairment Moderate: renal impairment, worsening renal functions, no indication for acute dialysis Severe: complicated by acute renal failure, metabolic and acid-base derangements, pulmonary oedema, multi-organ failure

Mild - evidence of rhabdomyolysis (eg haemoglobinuria) Mod - evidence of rhabdomyolysis with self-limiting or resolving sequelae (AKI, electrolyte disturbance) Severe - evidence of rhabdomyolysis with sequelae needing urgent intervention or non-renal organ injury (ARF, electrolyte disturbances)

Mild: CK >1000 and <3000/L and normal creatinine Moderate: CK >3000 and <5000/L and normal creatinine Severe: CK >3000/L and creatinine >100 micromole/l

mild - moderate - servere -

In order to classify Crush syndrome within itself, the entire physiopathology resulting from the syndrome must be mastered. In fact, according to my opinion, which I can support with lietarture, it may be more logical to classify this syndrome as very emergency, emergency, and long term (urgency) rather than mild, moderate and severe. I have this opinion because of the following: Let's think an earthquake and a patient under the collapse. As soon as the weight on the limb is removed, intracellular neuromediators, electrolytes and breakdown products such as creatine kinase are distributed throughout the system and have a separate effect on each system. The first and most rapidly affected system is the vascular endothelium due to the NOS system, causing a severe vasodilation in the injured person. This can trigger a state of shock in the patient and it is a mortal clinic that occurs in the very emergency period (is usually a pre-hospital period). The most valuable parameters here are the changes in vital parameters that the system responds to shock. In the emergency period, the effects of intracellular electrolytes and CK distributed in the system on the kidney, CNS and

Please describe how you would further classify the spectrum of crush syndro...

heart. These are associated with mortality independent of the clinical course in the emergency period. In the long term or urgency period, they include limb loss, renal failure and disability in the patient.

The manifestations may range from asymptomatic biochemical abnormalities to acute kidney injury requiring dialysis.

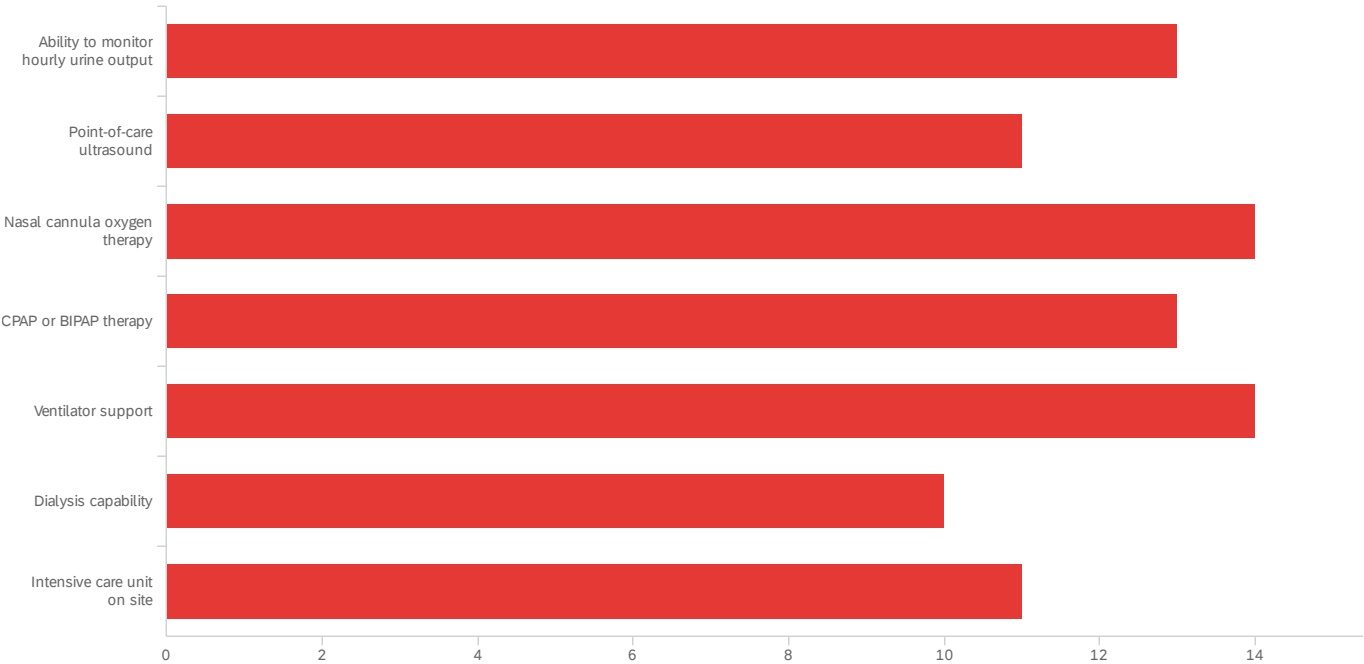
Mild - localized symptoms, laboratory findings that do not have clinical meaning (e.g. no change in urine color) Moderate - systemic symptoms including changes in UOP or changes in urine color Severe - metabolic derangements from the resulting systemic response (e.g. hyper K found on ECG, arrhythmias, flank pain)

Q8.2 - Please explain why you believe that crush syndrome is NOT a spectrum of disease.

Please explain why you believe that crush syndrome is NOT a spectrum of dis...

once renal impairment is evident, i would label the patient as having crush syndrome

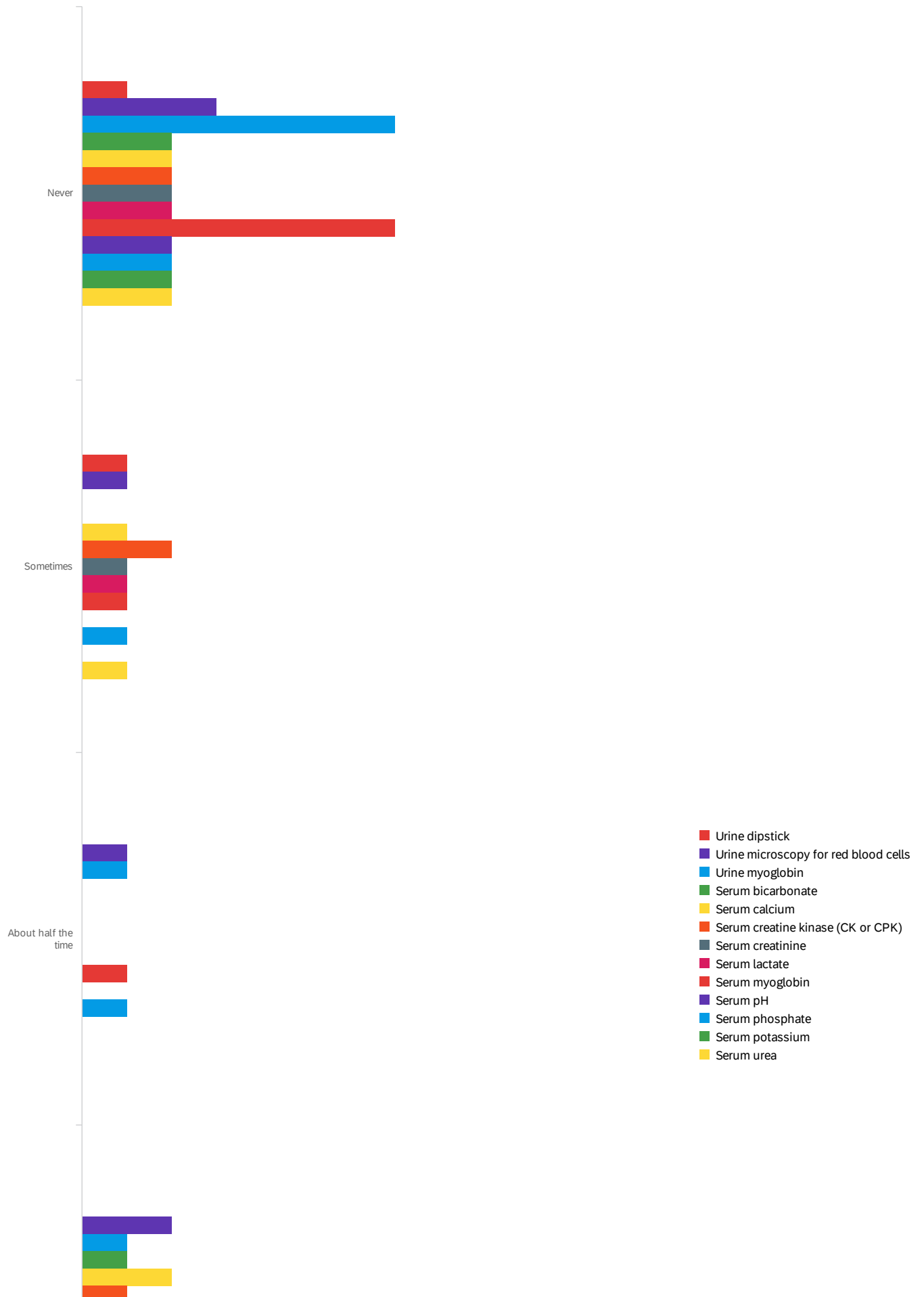
Q9 - What resources are available in your place of work where you are treating patients with crush syndrome? (check all that apply)

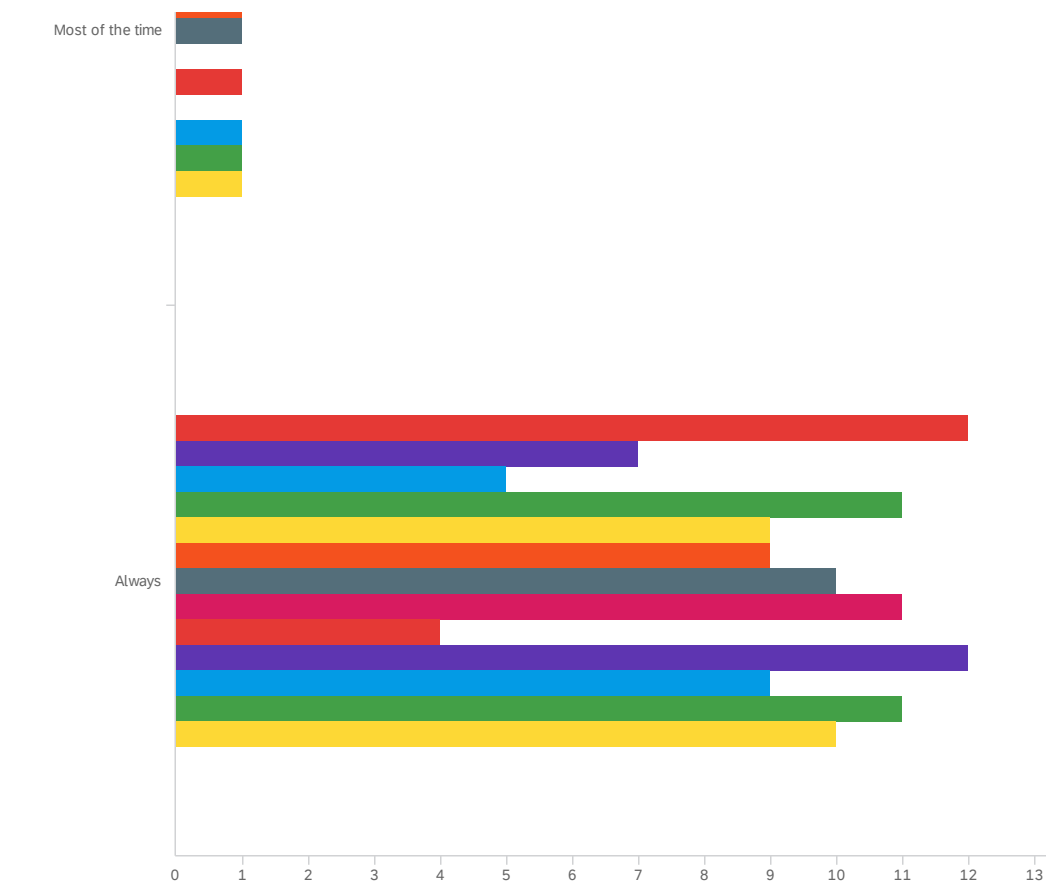


#	Field	Choice Count
1	Ability to monitor hourly urine output	15.12% 13
2	Point-of-care ultrasound	12.79% 11
3	Nasal cannula oxygen therapy	16.28% 14
4	CPAP or BIPAP therapy	15.12% 13
5	Ventilator support	16.28% 14
6	Dialysis capability	11.63% 10
7	Intensive care unit on site	12.79% 11
		86

Showing rows 1 - 8 of 8

Q10 - HOW OFTEN are you able to access the following laboratory data on your patients with crush injury in your place of work within a time frame that is useful for clinical decision-making?





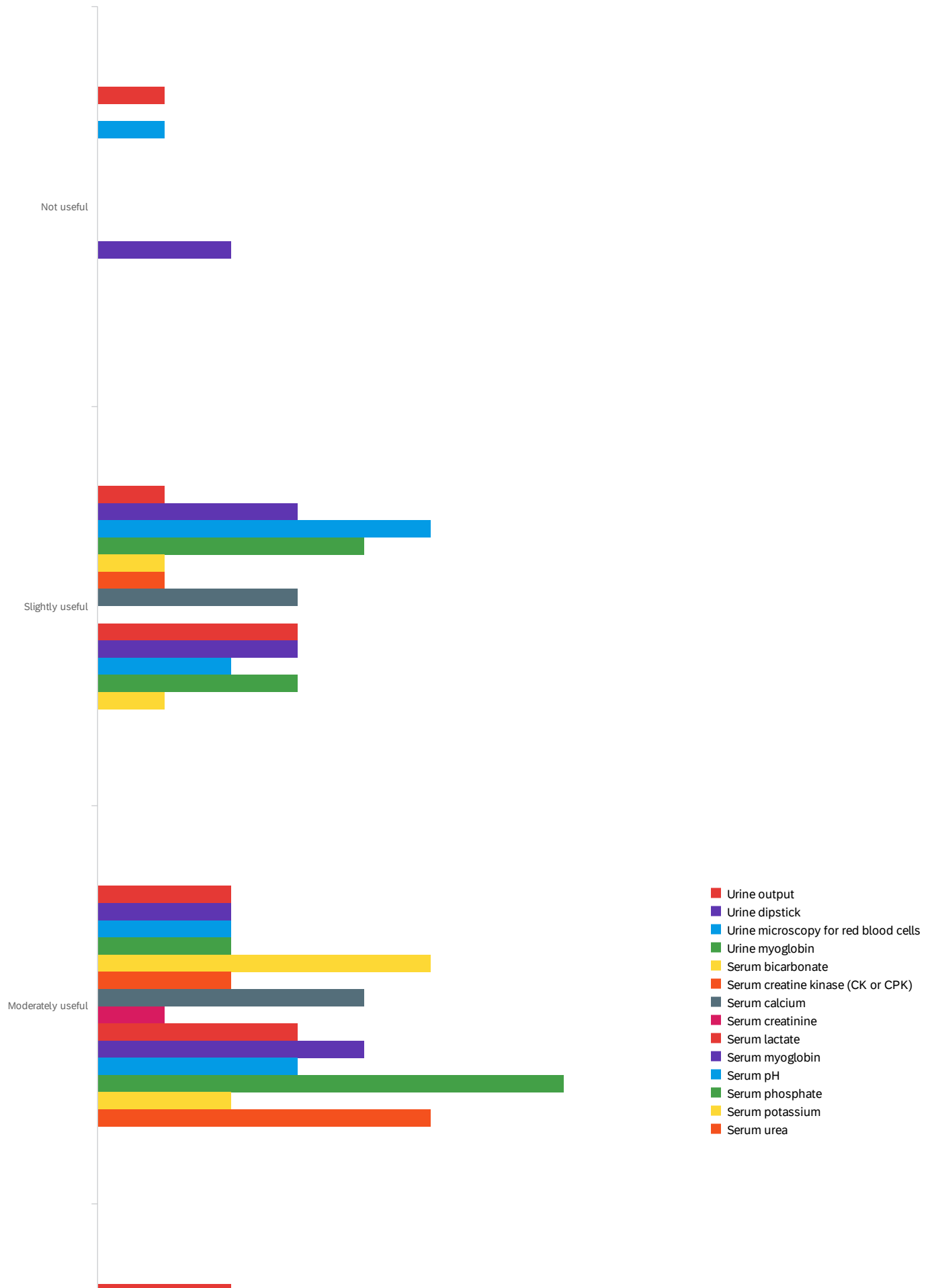
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Urine dipstick	1.00	5.00	4.50	1.24	1.54	14
2	Urine microscopy for red blood cells	1.00	5.00	3.64	1.63	2.66	14
3	Urine myoglobin	1.00	5.00	2.79	1.86	3.45	14
4	Serum bicarbonate	1.00	5.00	4.36	1.39	1.94	14
5	Serum calcium	1.00	5.00	4.07	1.49	2.21	14
6	Serum creatine kinase (CK or CPK)	1.00	5.00	3.93	1.58	2.49	14
7	Serum creatinine	1.00	5.00	4.14	1.51	2.27	14
8	Serum lactate	1.00	5.00	4.21	1.52	2.31	14
9	Serum myoglobin	1.00	5.00	2.57	1.76	3.10	14
10	Serum pH	1.00	5.00	4.43	1.40	1.96	14
11	Serum phosphate	1.00	5.00	4.00	1.51	2.29	14
12	Serum potassium	1.00	5.00	4.36	1.39	1.94	14

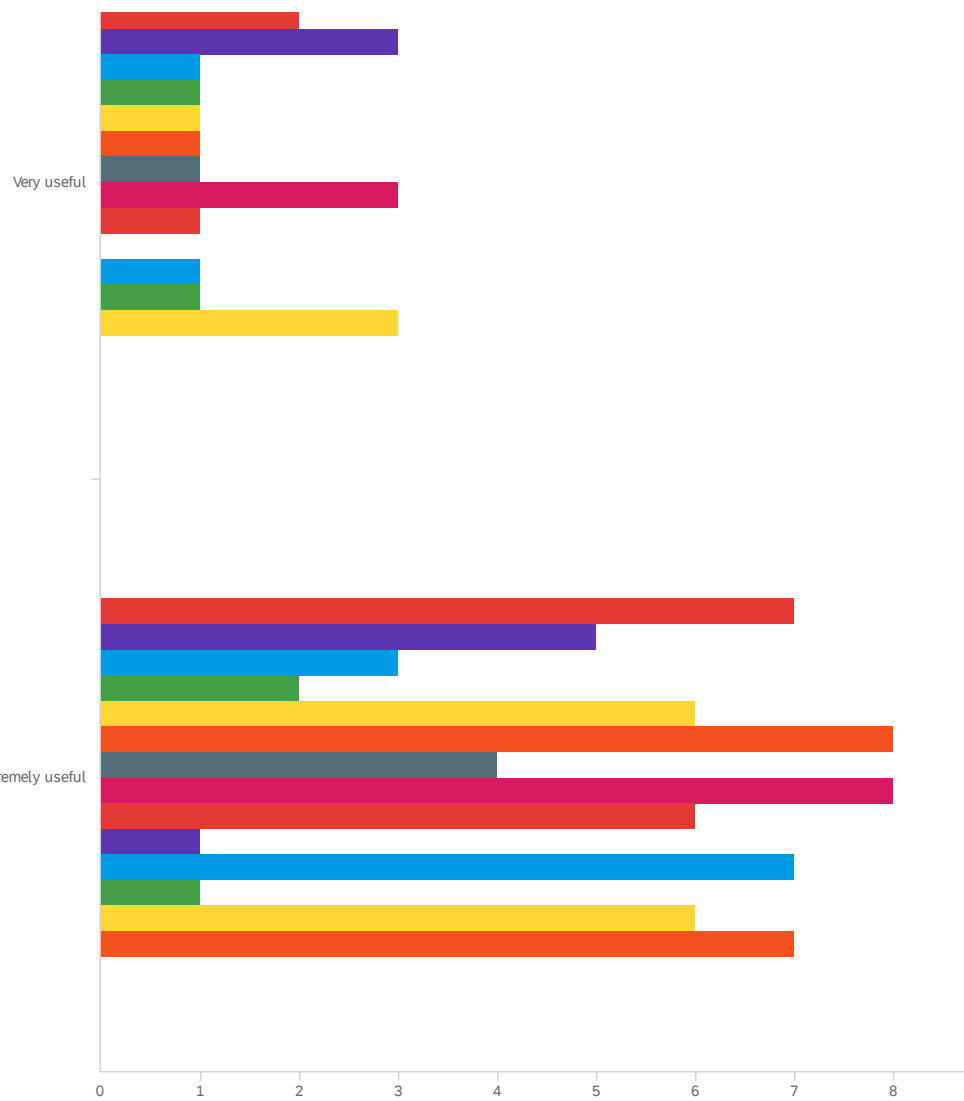
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
13	Serum urea	1.00	5.00	4.14	1.51	2.27	14

#	Field	Never	Sometimes	About half the time	Most of the time	Always	Total
1	Urine dipstick	7.14% 1	7.14% 1	0.00% 0	0.00% 0	85.71% 12	14
2	Urine microscopy for red blood cells	21.43% 3	7.14% 1	7.14% 1	14.29% 2	50.00% 7	14
3	Urine myoglobin	50.00% 7	0.00% 0	7.14% 1	7.14% 1	35.71% 5	14
4	Serum bicarbonate	14.29% 2	0.00% 0	0.00% 0	7.14% 1	78.57% 11	14
5	Serum calcium	14.29% 2	7.14% 1	0.00% 0	14.29% 2	64.29% 9	14
6	Serum creatine kinase (CK or CPK)	14.29% 2	14.29% 2	0.00% 0	7.14% 1	64.29% 9	14
7	Serum creatinine	14.29% 2	7.14% 1	0.00% 0	7.14% 1	71.43% 10	14
8	Serum lactate	14.29% 2	7.14% 1	0.00% 0	0.00% 0	78.57% 11	14
9	Serum myoglobin	50.00% 7	7.14% 1	7.14% 1	7.14% 1	28.57% 4	14
10	Serum pH	14.29% 2	0.00% 0	0.00% 0	0.00% 0	85.71% 12	14
11	Serum phosphate	14.29% 2	7.14% 1	7.14% 1	7.14% 1	64.29% 9	14
12	Serum potassium	14.29% 2	0.00% 0	0.00% 0	7.14% 1	78.57% 11	14
13	Serum urea	14.29% 2	7.14% 1	0.00% 0	7.14% 1	71.43% 10	14

Showing rows 1 - 13 of 13

Q11 - Please indicate how USEFUL the following clinical or laboratory data are in the
DIAGNOSIS of crush syndrome in your clinical practice environment.





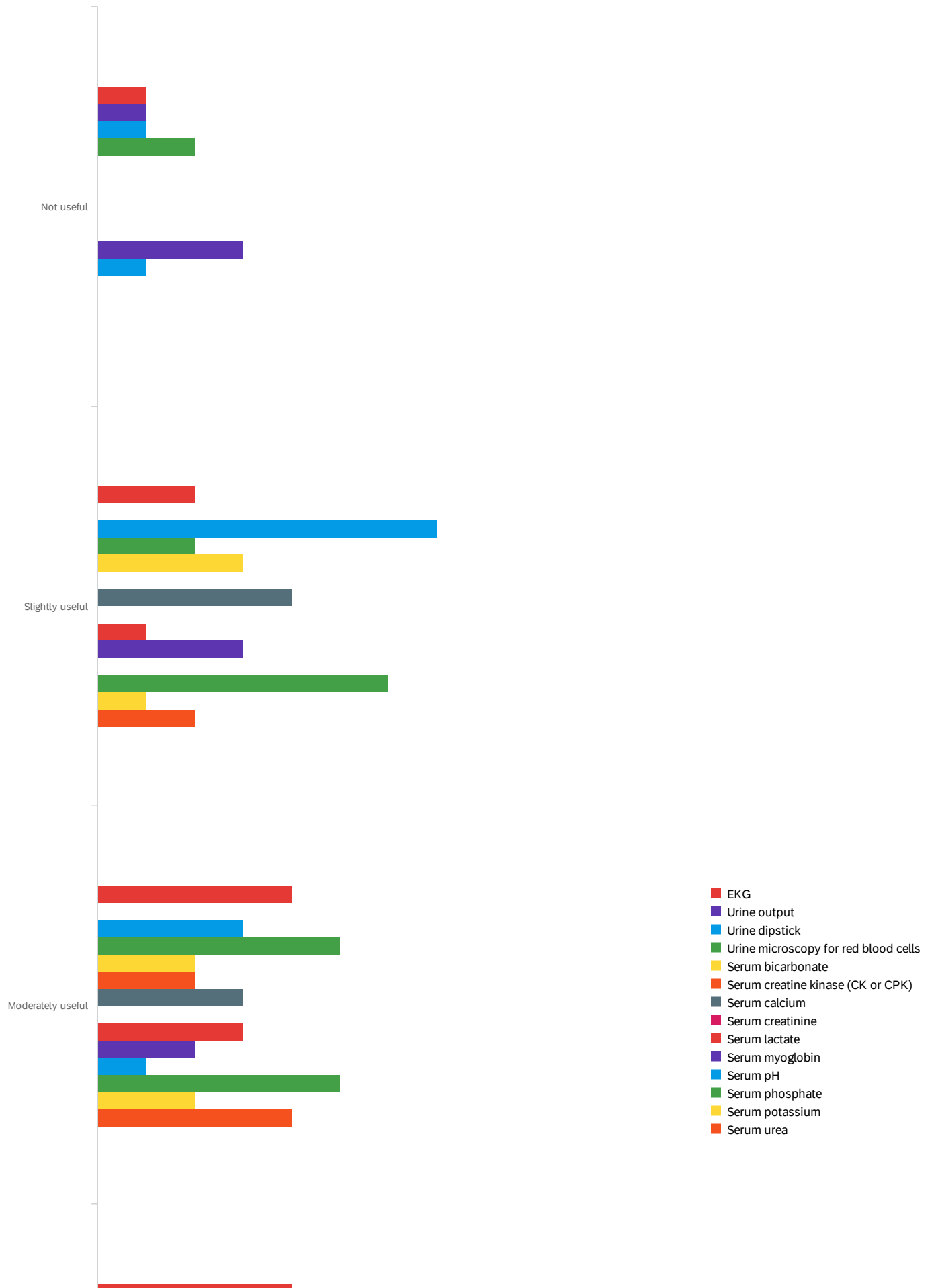
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Urine output	1.00	5.00	4.00	1.30	1.69	13
2	Urine dipstick	2.00	5.00	3.77	1.19	1.41	13
3	Urine microscopy for red blood cells	1.00	5.00	3.00	1.35	1.83	12
4	Urine myoglobin	2.00	5.00	3.11	1.20	1.43	9
5	Serum bicarbonate	2.00	5.00	3.92	1.07	1.15	13
6	Serum creatine kinase (CK or CPK)	2.00	5.00	4.33	1.03	1.06	12
7	Serum calcium	2.00	5.00	3.50	1.19	1.42	12
8	Serum creatinine	3.00	5.00	4.58	0.64	0.41	12
9	Serum lactate	2.00	5.00	3.77	1.25	1.56	13

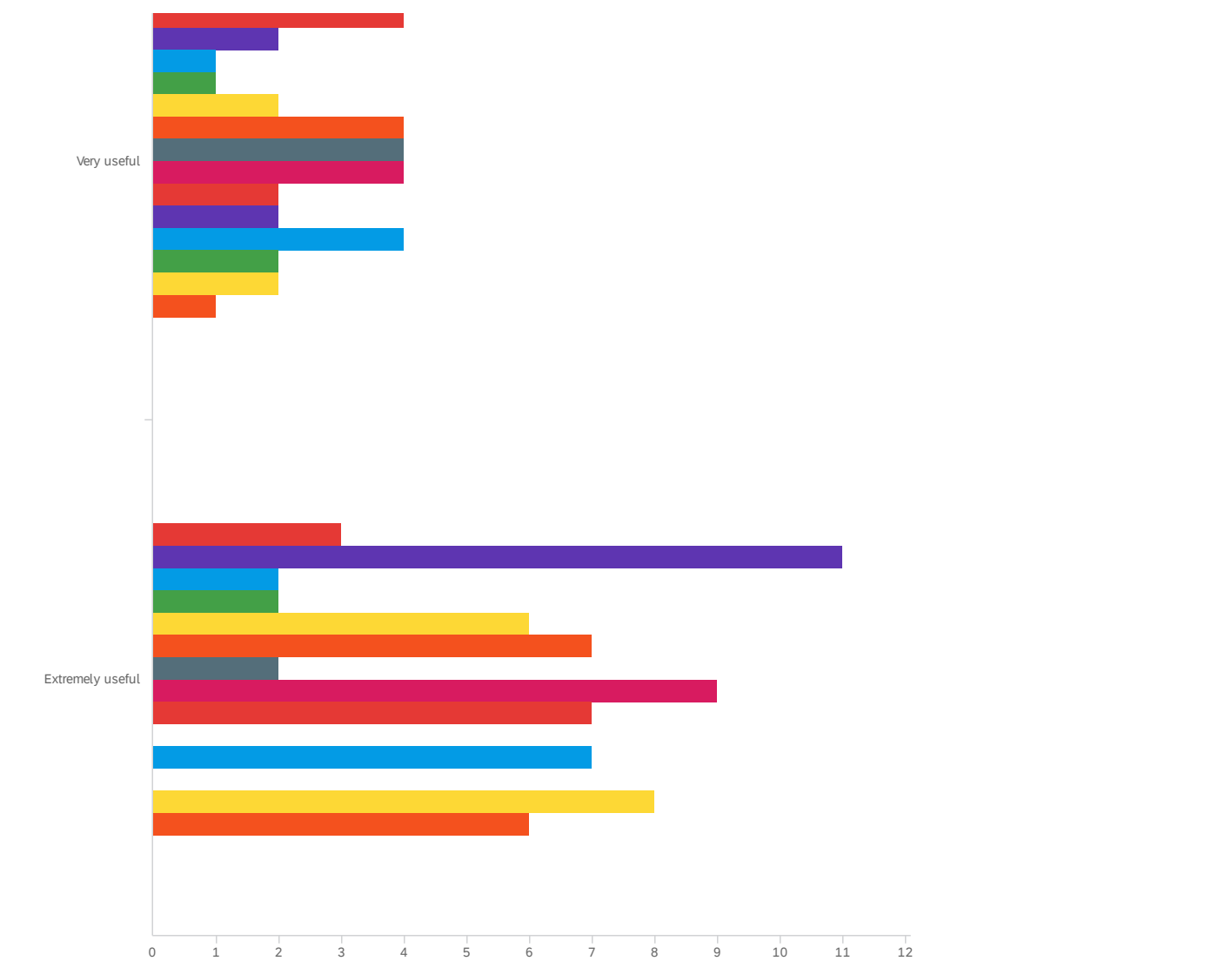
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
10	Serum myoglobin	1.00	5.00	2.50	1.12	1.25	10
11	Serum pH	2.00	5.00	4.00	1.18	1.38	13
12	Serum phosphate	2.00	5.00	3.00	0.82	0.67	12
13	Serum potassium	2.00	5.00	4.17	0.99	0.97	12
14	Serum urea	3.00	5.00	4.17	0.99	0.97	12

#	Field	Not useful		Slightly useful		Moderately useful		Very useful		Extremely useful		Total
1	Urine output	7.69%	1	7.69%	1	15.38%	2	15.38%	2	53.85%	7	13
2	Urine dipstick	0.00%	0	23.08%	3	15.38%	2	23.08%	3	38.46%	5	13
3	Urine microscopy for red blood cells	8.33%	1	41.67%	5	16.67%	2	8.33%	1	25.00%	3	12
4	Urine myoglobin	0.00%	0	44.44%	4	22.22%	2	11.11%	1	22.22%	2	9
5	Serum bicarbonate	0.00%	0	7.69%	1	38.46%	5	7.69%	1	46.15%	6	13
6	Serum creatine kinase (CK or CPK)	0.00%	0	8.33%	1	16.67%	2	8.33%	1	66.67%	8	12
7	Serum calcium	0.00%	0	25.00%	3	33.33%	4	8.33%	1	33.33%	4	12
8	Serum creatinine	0.00%	0	0.00%	0	8.33%	1	25.00%	3	66.67%	8	12
9	Serum lactate	0.00%	0	23.08%	3	23.08%	3	7.69%	1	46.15%	6	13
10	Serum myoglobin	20.00%	2	30.00%	3	40.00%	4	0.00%	0	10.00%	1	10
11	Serum pH	0.00%	0	15.38%	2	23.08%	3	7.69%	1	53.85%	7	13
12	Serum phosphate	0.00%	0	25.00%	3	58.33%	7	8.33%	1	8.33%	1	12
13	Serum potassium	0.00%	0	8.33%	1	16.67%	2	25.00%	3	50.00%	6	12
14	Serum urea	0.00%	0	0.00%	0	41.67%	5	0.00%	0	58.33%	7	12

Showing rows 1 - 14 of 14

Q12 - Please indicate how USEFUL the following clinical or laboratory data are in the PROGNOSTICATION of patients with crush syndrome in your clinical practice environment. Think about how these variables help you make disposition decisions for these patients (eg. where to transport, what level of care, whether to transfer to other facility).





#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	EKG	1.00	5.00	3.43	1.18	1.39	14
2	Urine output	1.00	5.00	4.57	1.05	1.10	14
3	Urine dipstick	1.00	5.00	2.71	1.16	1.35	14
4	Urine microscopy for red blood cells	1.00	5.00	2.92	1.26	1.58	12
5	Serum bicarbonate	2.00	5.00	3.85	1.23	1.51	13
6	Serum creatine kinase (CK or CPK)	3.00	5.00	4.38	0.74	0.54	13
7	Serum calcium	2.00	5.00	3.31	1.07	1.14	13
8	Serum creatinine	4.00	5.00	4.69	0.46	0.21	13
9	Serum lactate	2.00	5.00	4.15	1.03	1.05	13

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
10	Serum myoglobin	1.00	4.00	2.30	1.10	1.21	10
11	Serum pH	1.00	5.00	4.23	1.12	1.25	13
12	Serum phosphate	2.00	4.00	2.69	0.72	0.52	13
13	Serum potassium	2.00	5.00	4.31	0.99	0.98	13
14	Serum urea	2.00	5.00	3.85	1.17	1.36	13

#	Field	Not useful		Slightly useful		Moderately useful		Very useful		Extremely useful		Total
1	EKG	7.14%	1	14.29%	2	28.57%	4	28.57%	4	21.43%	3	14
2	Urine output	7.14%	1	0.00%	0	0.00%	0	14.29%	2	78.57%	11	14
3	Urine dipstick	7.14%	1	50.00%	7	21.43%	3	7.14%	1	14.29%	2	14
4	Urine microscopy for red blood cells	16.67%	2	16.67%	2	41.67%	5	8.33%	1	16.67%	2	12
5	Serum bicarbonate	0.00%	0	23.08%	3	15.38%	2	15.38%	2	46.15%	6	13
6	Serum creatine kinase (CK or CPK)	0.00%	0	0.00%	0	15.38%	2	30.77%	4	53.85%	7	13
7	Serum calcium	0.00%	0	30.77%	4	23.08%	3	30.77%	4	15.38%	2	13
8	Serum creatinine	0.00%	0	0.00%	0	0.00%	0	30.77%	4	69.23%	9	13
9	Serum lactate	0.00%	0	7.69%	1	23.08%	3	15.38%	2	53.85%	7	13
10	Serum myoglobin	30.00%	3	30.00%	3	20.00%	2	20.00%	2	0.00%	0	10
11	Serum pH	7.69%	1	0.00%	0	7.69%	1	30.77%	4	53.85%	7	13
12	Serum phosphate	0.00%	0	46.15%	6	38.46%	5	15.38%	2	0.00%	0	13
13	Serum potassium	0.00%	0	7.69%	1	15.38%	2	15.38%	2	61.54%	8	13
14	Serum urea	0.00%	0	15.38%	2	30.77%	4	7.69%	1	46.15%	6	13

Showing rows 1 - 14 of 14

Q13 - Are there any other laboratory data or clinical variables (including vital signs, physical exam findings) not listed above that you routinely use for the DIAGNOSIS of crush syndrome?

Are there any other laboratory data or clinical variables (including vital...

very difficult, if not impossible in the pre-hospital setting

For severe cases, the early response to initiation of CRRT, particularly improvement in pH over the first 1-2 hours.

Standard vital signs in prehospital setting.

AST, ALT

no

No

None

History of mechanism of injury vital signs and physical examination

Clinical variables more often assist in diagnosing crush injury.

signs of contusion/extensive blunt injury- not always reliable

None

Nothing to add.

no

Exam findings (e.g. firm compartments), coagulation studies if severe, ultrasound for changes in arterial flow patterns (if severe)

Q14 - Are there any other laboratory data or clinical variables (including vital signs, physical exam findings) not listed above that you routinely use for PROGNOSTICATION of patients with crush syndrome?

Are there any other laboratory data or clinical variables (including vital...

None - since even diagnosis is not possible

Trend of CPK

No

AST, ALT

GCS, Respiratory rate, Heart rate, MAP, GCS

No

None

vital signs and trend

N/A

Vital signs- tachycardia, hypotension

In our clinic, the SAFE-QUAKE exclusion scoring system was developed which includes entrapment duration (<45 hours), pH levels (>7.31), creatinine levels (<2mg/dL), LDH levels (<1600mg/dL) and AST-ALT ratio (<2.4) as the main determinants of dialysis requirements in patients with Crush injury.

Nothing to add.

no

No

Q15 - How does time since injury affect your decision making and use of data?

How does time since injury affect your decision making and use of data?

Useful as a rough guide of prognosis in the absence of laboratory results

Primarily for surgical decision making regarding re-perfusion of ischemic tissue.

Depends on severity, would guide treatment.

It's quite affecting.

For a better outcome, the early IF fluid is initiated the better, so if the time of injury to initiation of Fluid administration is long, the outcome will be negatively impacted.

Time since injury is a critical factor. Two patients can arrive after community assault, both with CK 7000, with crush injuries only. Patient A makes it to hospital within two hours post assault and is promptly fluid resuscitated. He does well and is discharged the next day. Patient B goes into hiding after the assault for more than 24 hours, without access to water, and finally makes it to hospital, markedly dehydrated. Despite aggressive fluid resuscitation he develops ARF and requires RRT. For this reason we do not use CK as a diagnostic tool or a prognosticator for Crush syndrome. Venous bicarbonate is a real-time indicator of how the kidney is doing, even before Urea and Creatinine levels are available or become abnormal. Venous bicarbonate is easy to obtain, rapidly performed at the coal face, and can be repeated regularly during the resuscitation process.

It will influence how data is interpreted in light of the injuries sustained to determine whether crush syndrome could have developed in the time since injury.

A lot of patients in our context arrive late after injury (>6-12 hours) so generally a disposition is made fairly soon after initial stabilisation and resuscitation. Does the patient require dialysis/ ventilatory support and hence transfer to a definitive treatment facility or ICU or can the patient stay at district hospital level or in the trauma unit for fluid resuscitation and monitoring.

In my experience, crush injury/syndrome diagnosis can be made any time after injury, anecdotally after 6 hours but within 3-5 days.

If diagnostic criteria for crush syndrome not met in a patient where there was a shorter time since injury this may prompt longer observation period or repeat investigations while management for presumed crush syndrome continue compared to a patient with a longer time since injury where crush syndrome may be more readily excluded if the initial investigations were normal.

In our clinic, the SAFE-QUAKE exclusion scoring system was developed which include entrapment duration (<45 hours).

Timing of the results plays a big role in diagnosis and management of the patient. As an example, the absence of myoglobinuria does not exclude crush syndrome 12-24 hours after the injury. Hyperkalaemia is one of the first biochemical changes. Haemoconcentration occurs soon after rhabdomyolysis, causing hypernatraemia, increased hematocrit and hemoglobin concentrations, as well as raised urea and creatinine (pre-renal AKI).

if more time has passed and values are normal i would be more willing to exclude crush syndrome, early abnormal values in terms of renal function would be of greater concern to me

Depends on the current interventions in place (e.g. tourniquet), but otherwise it is helpful for prognostication

Q16 - Please explain if/how you use serial re-examinations or testing to arrive at clinical decisions for patients with crush injury.

Please explain if/how you use serial re-examinations or testing to arrive a...

not really possible in the pre-hospital environment. Was possible during the Haitian response but more out of poor structures than intention.

Severe acidosis not controlled with CRRT indicates need for amputation or major debridement.

.

We use a chart created by Sever and Vanholder. Sever MS, Vanholder R; RDRTF of ISN Work Group on Recommendations for the Management of Crush Victims in Mass Disasters. Recommendation for the management of crush victims in mass disasters. Nephrol Dial Transplant. 2012;27 Suppl 1:i1-67.

Endpoints to the resuscitation need to be established and serial testing and re-examination are primordial to achieve those endpoints.

We follow the trend of the venous bicarbonate level, which grades the severity of the crush syndrome and guides management: Mild: VB >22: IV crystalloid to produce urine output 1-2 mL/kg/hr. Discharge once VB normal, U&E normal, urine output remains satisfactory. Moderate: VB >17: As above. Monitor closely for the possibility of worsening into severe category. Severe: VB <17: Fluid challenge, monitor. Avoid fluid overload. Most of these patients will be oliguric/anuric, will worsen, and develop the need for RRT. References: Muckart DJ, Moodley M, Naidu AG, Reddy AD, Meineke KR. Prediction of acute renal failure following soft-tissue injury using the venous bicarbonate concentration. J Trauma. 1992;33(6):813-7. doi: 10.1097/00005373-199212000-00003. Skinner DL, Laing GL, Bruce J, Biccadd B, Muckart DJJ. Validating the utilisation of venous bicarbonate as a predictor of acute kidney injury in crush syndrome from sjambok injuries. S Afr Med J. 2017;107(5):446-450. doi: 10.7196/SAMJ.2017.v107i5.12213.

Serial re-examinations are used in the following ways: Repeated vital sign testing every hour. Repeated clinical examination 4 hourly Urine dipstick testing 4 hourly Input-output monitoring 12hourly Serial blood gases 4 hourly Serial serum electrolyte, CK, urea, and creatinine testing daily Daily ECGs

Yes. As above. Disposition is the ultimate goal. Serial monitoring and testing to determine change in clinical condition and therefore requiring transfer/ scaling up treatment or step down

Hourly urine output is charted, as well as daily dipsticks. Other lab parameters repeated daily until normalised. ABG only done on admission and if clinical picture is suggestive of deterioration.

In a patient with a short time since injury, where crush syndrome is suspected but not confirmed on initial investigation serial dipstick will be done and further investigations done only if microscopic hematuria found. In a patient with confirmed crush syndrome- Urine output monitoring will be continuous, Repeat creatinine will be done every 24h (more frequently is not feasible in our setting), Patients with moderate to severe Crush syndrome should be referred to the next level of care as our setting does not allow for optimal monitoring and management of such cases, however due to bed pressures at the next level of care patients may end up in our EC for extended periods where we will continue with UO monitoring, continuous vitals monitoring, 4hly ABGs and Creatinine every 24h.

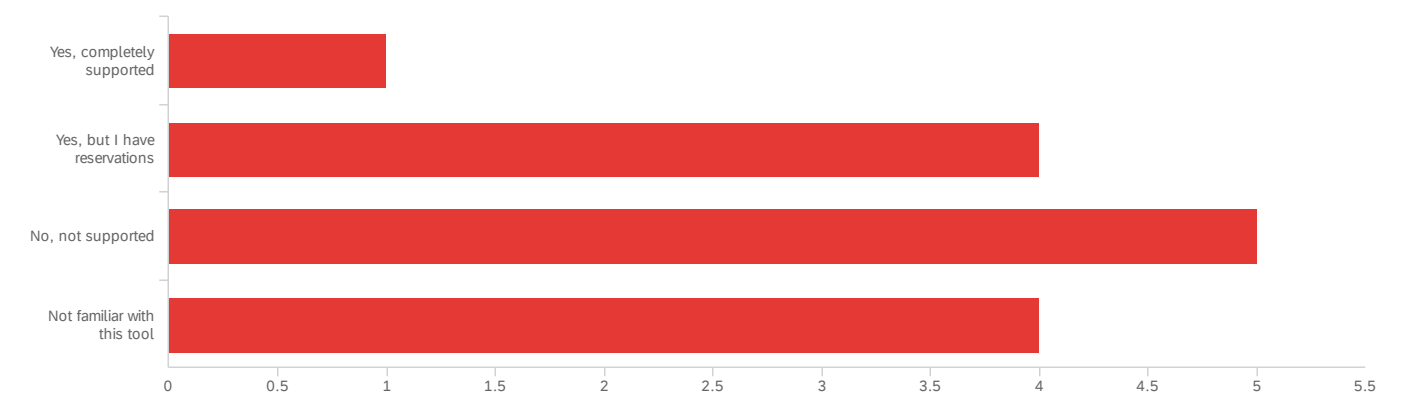
We dynamically monitor patients' vital parameters, urination and blood tests.

Serial potassium and creatinine concentrations in the first 24 hours following injury should be performed to assist with diagnosis when clinical suspicion remains high.

monitoring of Creat values daily, if abnormal K- 6hrly ABG for monitoring, hourly urine output ideal (but rarely done)

Serial ultrasound if severe, serial labs, e.g. CPK level somewhat helpful, potassium if severe

Q17 - Do you support the use of total body surface area that has sustained soft tissue injury (via the rule of 9's similar to that used for burn patients) in the prediction of crush syndrome for patients with crush injury?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you support the use of total body surface area that has sustained soft tissue injury (via the rule of 9's similar to that used for burn patients) in the prediction of crush syndrome for patients with crush injury?	1.00	4.00	2.86	0.91	0.84	14

#	Field	Choice Count
1	Yes, completely supported	7.14% 1
2	Yes, but I have reservations	28.57% 4
3	No, not supported	35.71% 5
4	Not familiar with this tool	28.57% 4

14

Q17.1 - Please provide justification for your response above regarding use of total body surface area injured in prediction of crush syndrome.

Please provide justification for your response above regarding use of total...

In the pre-hospital environment, lab findings are not useful (since they not available) so a tool that uses observable clinical findings will be immensely useful in directing treatment protocols

I don't think surface area is the same thing as volume of ischemic tissue, and ischemia may be relative depending on the environmental temperature and some degree of perfusion. However, although difficult to quantify, more ischemic tissue leads to more severe illness.

Not sure this relates into the severity or onset of crush syndrome

I think total body surface area would be clinically useless in the management of a patient with crush syndrome.

It is only necessary to have a suspicion that crush injury is present. BSA and CK can help confirm this suspicion but they do not tell you how the kidney is managing. VB gives you this information at an early stage, in conjunction with U&E results that follow later. Patients with similar BSA and/or similar CK values can have different renal outcomes.

Think it can be used to visually assist in determining the extent of muscle injury especially if one is situated rurally or junior doctors needing that prompt however so many things can hamper the determination/ full extent of the underlying muscle damage and its sequelae i.e skin colour, subcutaneous bruising not visible

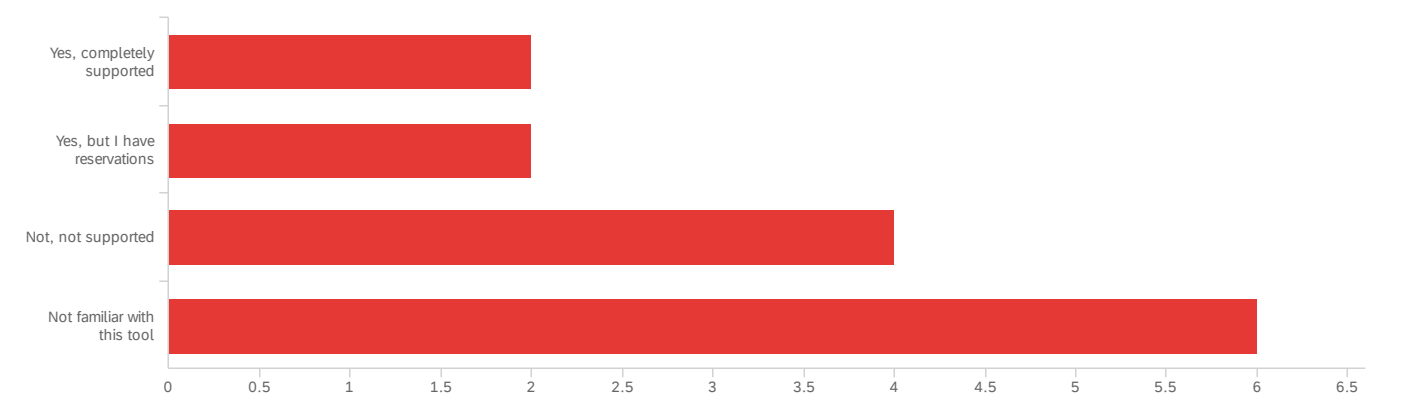
There are significant differences in the interpretation of what bruising looks like (redness vs swelling vs discoloration vs tender areas) and the rule of 9s has some problems (ie if only part of a 9% section is affected). Some practitioners may use a rule of palms where the pamar surface is 1% TBSA. All these tools lack standardisation in their application. Additionally, many practitioners assign special importance to certain type of injuries - for instance tramline bruising is regarded as a highly suggestive clinical sign. Also, bruising might not be very reliable in all types of crush injuries, for instance an extremity trapped for x number of hours may not be significantly bruised but may contribute to significant rhabdomyolysis.

Here, the nature of the compression that causes crush syndrome is also valuable and the anatomical area of compression alone would be an incomplete classification.

i do not think that TBSA correlates well with CK or index of suspicion

The rule of 9s is for surface area for burn purposes, not sure that it is totally applicable to muscle compartments and such; also not aware of validated tools that use fluid requirements based on rule of 9s for crush unlike burns (e.g. ISR rule of 10s)

Q18 - Do you support the use of point-of-care soft tissue ultrasound in the prediction of crush syndrome for patients with crush injury?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you support the use of point-of-care soft tissue ultrasound in the prediction of crush syndrome for patients with crush injury?	1.00	4.00	3.00	1.07	1.14	14

#	Field	Choice Count
1	Yes, completely supported	14.29% 2
2	Yes, but I have reservations	14.29% 2
3	Not, not supported	28.57% 4
4	Not familiar with this tool	42.86% 6

14

Q18.1 - Please provide justification for your response above regarding use of soft tissue ultrasound in prediction of crush syndrome.

Please provide justification for your response above regarding use of soft...

POCUS is part of the scope of pre-hospital providers (ALS) and as such could readily be available.

Perhaps in a different setting, but the need for training, currency and usefulness in the prehospital setting seems not to have benefit profile.

I do not believe that the use of ultrasound has any benefit in the management of crush syndrome.

Refer to answer 17.1

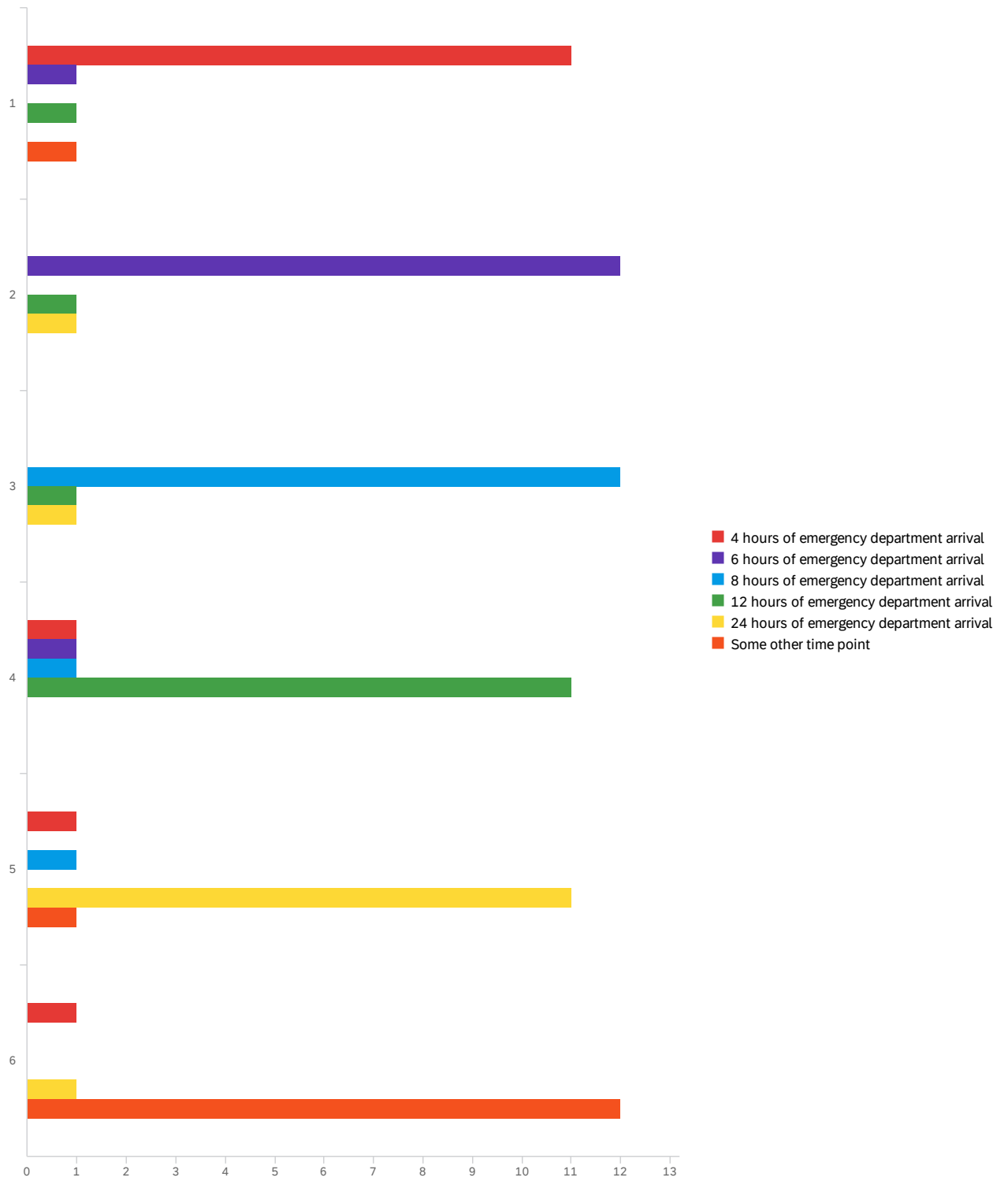
Need to have a comparator Adequate training in POCUS

It can be used as an adjunct to clinical prognostic factors, but research is needed to determine its contribution to clinical significance.

what is being assessed? no role for crush specific injury

It can help with measuring severity but is not as useful in mild cases

Q19 - We aim to develop a clinical predictive tool for the diagnosis and prognostication of crush syndrome. Please help us identify the time point at which such a clinical tool would be most useful. Please rank the following (top being your most preferred time point): The clinical predictive tool should incorporate data obtained within...



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	4 hours of emergency department arrival	1.00	6.00	1.86	1.68	2.84	14
2	6 hours of emergency department arrival	1.00	4.00	2.07	0.59	0.35	14
3	8 hours of emergency department arrival	3.00	5.00	3.21	0.56	0.31	14

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
4	12 hours of emergency department arrival	1.00	4.00	3.57	0.90	0.82	14
5	24 hours of emergency department arrival	2.00	6.00	4.71	0.96	0.92	14
6	Some other time point	1.00	6.00	5.57	1.29	1.67	14

#	Field	1		2		3		4		5		6		Total
1	4 hours of emergency department arrival	78.57%	11	0.00%	0	0.00%	0	7.14%	1	7.14%	1	7.14%	1	14
2	6 hours of emergency department arrival	7.14%	1	85.71%	12	0.00%	0	7.14%	1	0.00%	0	0.00%	0	14
3	8 hours of emergency department arrival	0.00%	0	0.00%	0	85.71%	12	7.14%	1	7.14%	1	0.00%	0	14
4	12 hours of emergency department arrival	7.14%	1	7.14%	1	7.14%	1	78.57%	11	0.00%	0	0.00%	0	14
5	24 hours of emergency department arrival	0.00%	0	7.14%	1	7.14%	1	0.00%	0	78.57%	11	7.14%	1	14
6	Some other time point	7.14%	1	0.00%	0	0.00%	0	0.00%	0	7.14%	1	85.71%	12	14

Showing rows 1 - 6 of 6

Q19.1 - Please explain your rationale for preferred time point. If you prefer 'some other time point,' please elaborate.

Please explain your rationale for preferred time point. If you prefer 'some...

As part of the treatment/assessment in the initial pre-hospital setting since these patients may present late

The time after ED arrival is somewhat irrelevant, especially in austere or rural areas where prehospital time may be prolonged. The time after injury is important, I would choose first 8 hours.

.

Patients should be diagnosed as soon as possible and transferred to the appropriate treatment or treatment center.

ideally after 4 hours of fluids resuscitation, the clinical predictive tool should incorporate data, but in my setting, many factors may delay the initial fluid management, reason for me to choose 6 hours.

Early prognostication is not always straightforward but is helpful. We see three categories of patients following community assaults: 1. Mild or moderate - improve quickly and go home within 24 hours. 2. Severe (will often present with "Coca-Cola urine") - remain oliguric/ anuric and land up needing RRT early. 3. Moderate to severe - pass adequate urine/ do not become oliguric, but develop marked AKI. Most do not require RRT but they remain in hospital for lengthy periods while their renal functions slowly return to normal. That said, we do expect the majority of our severe category patients to land up needing RRT, and those are diagnosed by VB shortly after admission and follow-up VB after initial fluid challenge. While Urea and Creatinine give the most accurate picture of renal welfare, (1) they tend to lag, and (2) if raised, they do not necessarily predict the need for RRT.

I think this time point represents one in which the clinical manifestations may be present and the time frame for intervention is optimal.

Some other point: on arrival in the EC - South African context: presentation to the ED may frequently be delayed by up to 24-36 hours. Community assault or IPV patients are often left next to a roadside/field and emergency services are not always contacted immediately/ at the time of injury so I would suggest it is important, in our context to evaluate the patient upon arrival to the ED initially and the 6, 12, 24 hours thereafter.

Sooner is better - this guides resource allocation in a restricted setting and allows for transfer if level of care isn't appropriate. With shorter timepoints there is the risk that the pathology hasn't yet had the time to fully mature. Yet given the delays in EC arrival at our facilities in general (multiple factors contribute) a timepoint like 24 hours may be a very exaggerated delay. 12 hours is a good middle ground.

4h- will assist with early ID and guidance as to management of the patient

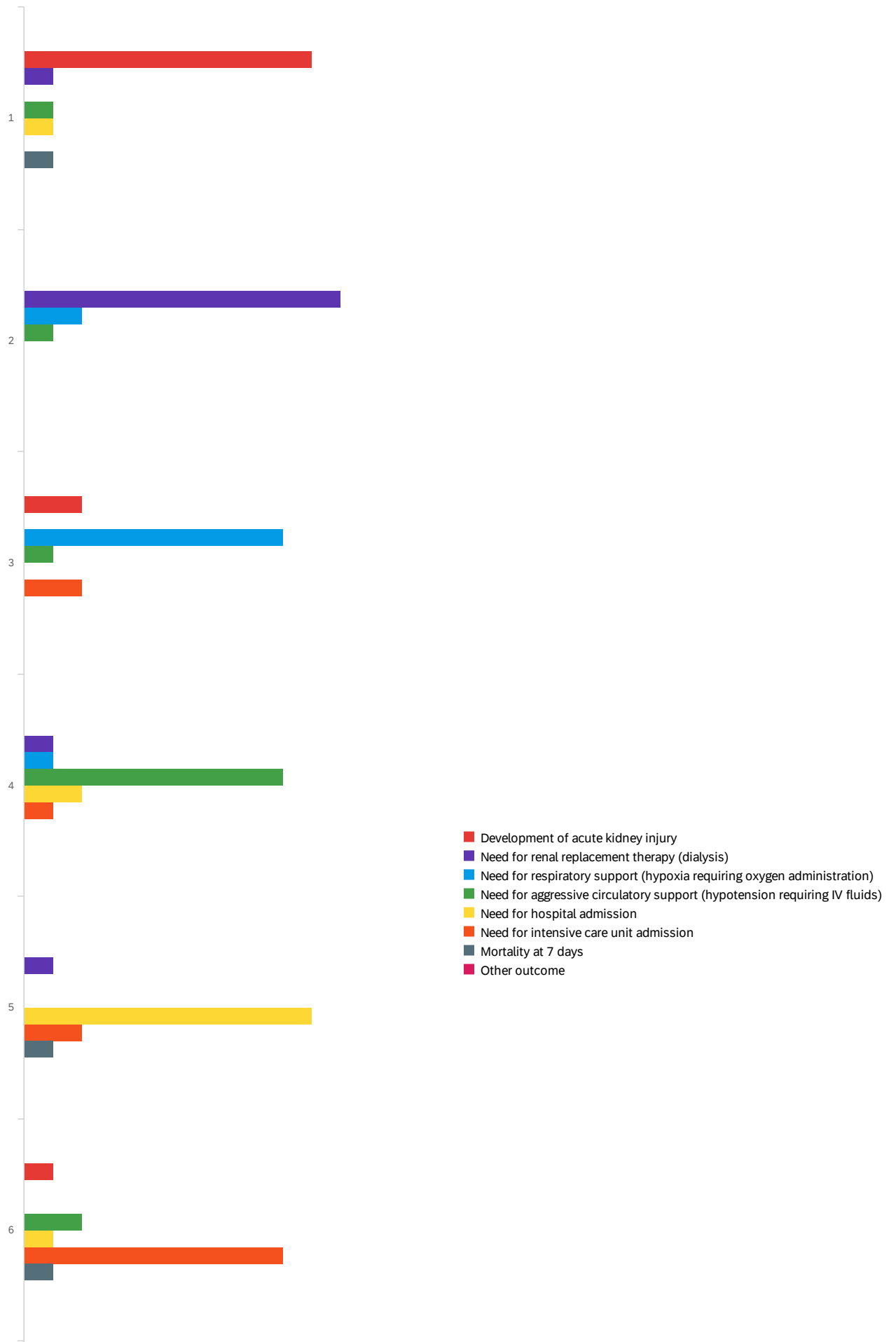
Moment of emergency room visit: The prognostic tool to be developed for these patients should evaluate them at the time of presentation to the emergency department. These patients usually present with cumulative injuries and process-based assessment tools would be useless. Because in these cases, the emergency department needs to be discharged quickly and therefore decisions should be made quickly. There is no place for follow-up in such cases.

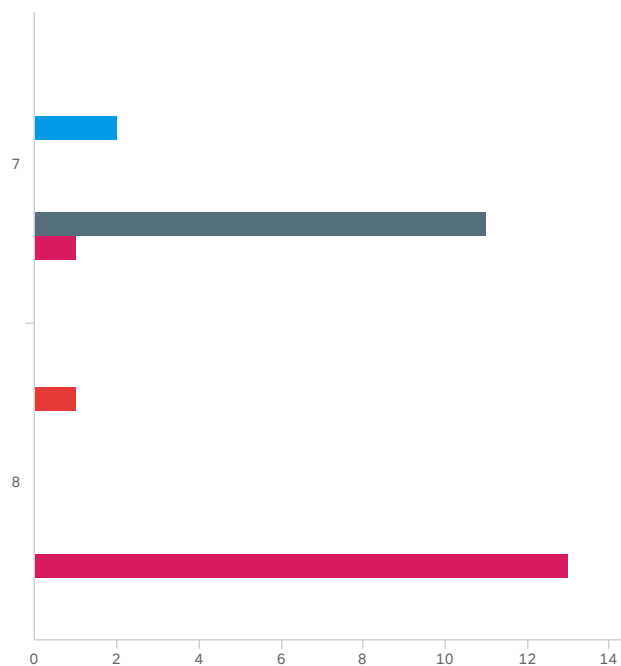
The early biochemical changes may be identified at this time point.

assessment @ 6hrs then 12hrs, allows the implementation of treatment with valid reassessment data taken into account

6 hours is within the safe range for tourniquet application, thus likely applicable to crush-type injuries that involve the same release of substrate into the circulation

Q20 - What clinical outcomes do you think are most important to predict for patients with crush syndrome? Please rank from most to least important (top being most important).





#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Development of acute kidney injury	1.00	8.00	2.14	2.13	4.55	14
2	Need for renal replacement therapy (dialysis)	1.00	5.00	2.29	0.96	0.92	14
3	Need for respiratory support (hypoxia requiring oxygen administration)	2.00	7.00	3.50	1.50	2.25	14
4	Need for aggressive circulatory support (hypotension requiring IV fluids)	1.00	6.00	3.86	1.25	1.55	14
5	Need for hospital admission	1.00	6.00	4.64	1.11	1.23	14
6	Need for intensive care unit admission	3.00	6.00	5.29	1.10	1.20	14
7	Mortality at 7 days	1.00	7.00	6.36	1.59	2.52	14
8	Other outcome	7.00	8.00	7.93	0.26	0.07	14

#	Field	1	2	3	4	5	6	7	8
1	Development of acute kidney injury	71.43% 10	0.00% 0	14.29% 2	0.00% 0	0.00% 0	7.14% 1	0.00% 0	7.14%
2	Need for renal replacement therapy (dialysis)	7.14% 1	78.57% 11	0.00% 0	7.14% 1	7.14% 1	0.00% 0	0.00% 0	0.00%
3	Need for respiratory support (hypoxia	0.00% 0	14.29% 2	64.29% 9	7.14% 1	0.00% 0	0.00% 0	14.29% 2	0.00%

#	Field	1	2	3	4	5	6	7	8
	requiring oxygen administration)								
4	Need for aggressive circulatory support (hypotension requiring IV fluids)	7.14% 1	7.14% 1	7.14% 1	64.29% 9	0.00% 0	14.29% 2	0.00% 0	0.00%
5	Need for hospital admission	7.14% 1	0.00% 0	0.00% 0	14.29% 2	71.43% 10	7.14% 1	0.00% 0	0.00%
6	Need for intensive care unit admission	0.00% 0	0.00% 0	14.29% 2	7.14% 1	14.29% 2	64.29% 9	0.00% 0	0.00%
7	Mortality at 7 days	7.14% 1	0.00% 0	0.00% 0	0.00% 0	7.14% 1	7.14% 1	78.57% 11	0.00%
8	Other outcome	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	0.00% 0	7.14% 1	92.86%

Showing rows 1 - 8 of 8

Q20.1 - Please explain your rationale above regarding the most important clinical outcomes to predict. If you prefer some 'other outcome,' please elaborate.

Please explain your rationale above regarding the most important clinical o...

in our context - this is not readily available and thus few would be able to access it in time.

1. Mortality 2. Other-amputation 3. Need for RRT 4. Need for respiratory support 5. Need for ICU admission 6. Need for aggressive circulatory support 7. Need for hospital admission

.

All of the above are important clinical implications. However, since the devices used for dialysis and respiratory support may be limited in number in hospitals, they may not be able to meet the demand, so these clinical results should be taken into consideration more.

If renal failure is worsening despite appropriate fluid and electrolyte management, the metabolic disturbances that result from that will cause a Multiple organ failure. Therefore, once we reach the point of need for dialysis, the clinical outcomes become concerning.

An early decision should be made as to whether a patient needs admission or may be fluid managed in the ED. RRT is the most common major consequence of crush syndrome. Predicting the need for it may be helpful to clinicians at institutions where RRT is not available. While AKI is common, it is often not severe, and self-limiting, not requiring transfer to another institution. The next most common major consequence in our setting is fluid overload, pulmonary edema, the need for ventilation, and for ICU admission. Need for aggressive circulatory support is not a major issue in our unit, unless the patient has other injuries necessitating it. These patients will usually also have raised serum lactate, whereas most patients with pure crush syndrome do not.

I think a patient with crush injury who develops acute kidney injury should be assumed to have crush syndrome until proven otherwise.

Hypotension, need for aggressive resuscitation (fluid, etc) and/or respiratory support, in those initial phases of resuscitation I anecdotally find to be fairly good predictors of the clinical course. In our context labs are often delayed and the initial renal function results only available 6-12 hours after presentation so the extent of acute kidney injury are not known early on in the course. Need for RTT could be higher up but especially as it is frequently required, and potentially life-saving; in our clinical context (especially if the patient is not at a facility with a dialysis unit) it is not always available.

A tool that can help facilities prognosticate would assist facilities to identify the need for transfer ASAP. For instance, any facility can provide respiratory or circulatory support, but specialised care like RRT and ICU admission needs advance knowledge and arrangement to improve outcomes. Risk for AKI will assist in monitoring and guide treatment to prevent although no specialised intervention is necessary. Mortality at 7 days is good to know but doesn't have a lot of utility - better to know how to treat and at which level of care.

Quick tool so assist decision making- Which patients can be Discharged safely, who is at risk for AKI- need close monitoring of Input and output, Who need to be prioritized to be referred to next level of care-ICU admission needed/respiratory support/dialysis

As I mentioned at the beginning, I think there is a need for a process-based evaluation.

Small rises in serum creatinine is associated with high risk of in-hospital death even before the development of uremic complications or the need for dialysis.

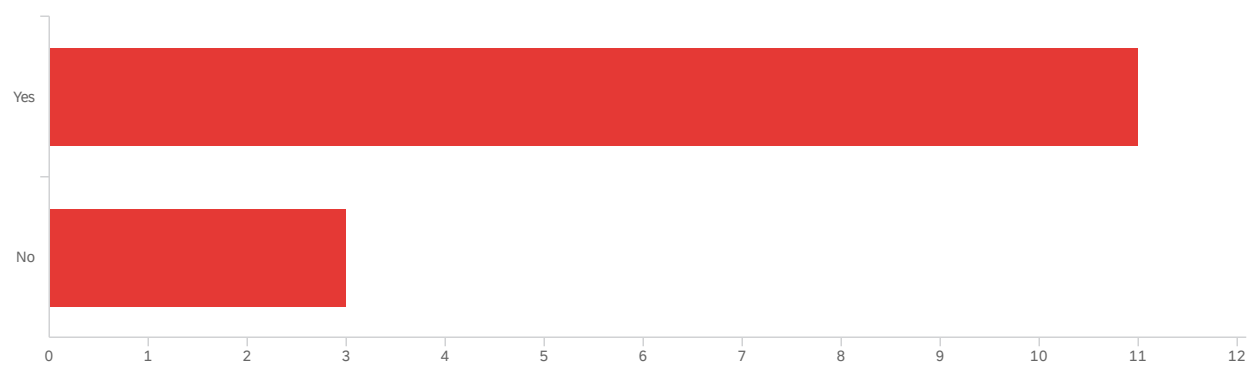
will help us see if AKI and RRT can be avoided

-Death is bad -dialysis costs money long term -ICU days are very expensive -aggressive circulatory support is nursing intensive -hospital days are not as expensive but not cheap, but if you can sustain with maintenance fluids its not nursing intensive -AKI usually resolves in young healthy

Please explain your rationale above regarding the most important clinical O...

people, not expensive, go home and drink some Gatorade -oxygen administration in and of itself is cheap everywhere but the deployed setting

Q21 - Do you believe the clinical predictive model should predict a COMPOSITE outcome? (Multiple endpoints are combined in a composite outcome. For example, combining need for dialysis, ICU admission or death, would be a composite outcome).



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you believe the clinical predictive model should predict a COMPOSITE outcome? (Multiple endpoints are combined in a composite outcome. For example, combining need for dialysis, ICU admission or death, would be a composite outcome).	1.00	2.00	1.21	0.41	0.17	14

#	Field	Choice Count
1	Yes	78.57% 11
2	No	21.43% 3

Q21.1 - Please elaborate on the variables you would include in this composite outcome.

(Should the clinical predictive model include a combination of outcomes? Which outcomes should be combined for the clinical predictive tool?)

Please elaborate on the variables you would include in this composite outco...

A combination of clinical findings (incl) POCUS and easily recordable metrics - not dependent on high cost or high skill lab findings

Not sure one outcome can accurately predict.

In addition to those you have mentioned above, surgical interventions such as fasciotomy and amputation

Need for dialysis, need for respiratory support, needs for ICU.

Increasing haemodynamic instability Acute kidney injury Need for ICU care Oliguria Myoglobinuria Requiring dialysis

Resuscitation need (hypotension, respiratory support, management of electrolyte derangements) Need for dialysis ICU admission Mortality at 7 days

Outcomes that suggest a higher level of care/intervention should be considered/anticipated could be combined: ICU admission, RRT, risk of death.

composite outcomes that will assist in indicating those that need to be prioritized for referral- ICU admission, dialysis

No additional suggestions

Age Sex Stage of AKI (e.g. KDIGO stage 1, 2 or 3) with or without the need for dialysis Mechanism of injury e.g. community assault vs. pedestrian vehicle accident. Mechanical ventilation APACHE II or SOFA scores Vasopressor requirements

Must only include the major outcomes only, combining a 25 year old with AKI with a death are not the same

Q21.2 - Please elaborate on why the model should not predict a composite outcome.

Please elaborate on why the model should not predict a composite outcome.

It may be less accurate and harder to apply to an individual patient.

Regarding the management of crush syndrome, we are fairly limited. The options used to include fluid challenge, alkaline diuresis, and mannitol. Most units have done away with the latter two, with only fluid challenge now remaining, and if that fails, RRT. In our unit we see a large number of crush syndromes from community assaults. Death is rare, but RRT is common among patients in the severe category. Those with fluid overload and pulmonary edema tend to require ventilation and ICU, but this cannot be predicted by a score on admission. Of course those who require ICU admission may land up developing VAP etc and have prolonged stay/ poorer outcomes. Patients who have injuries other than crush will of course also often do worse, but in that case a predictive score would no longer just be relevant to the crush syndrome alone.

-

Q22 - Please provide any final comments or suggestions.

Please provide any final comments or suggestions.

As the prehospital setting is resource austere - I would advocate for a stepped tool that looks at the initial stage (EMS and primary care) and then the specialized facility level. These should direct treatment pathways based on prognostic factors.

That's all

Interested in how this prognostic tool effects the treatment of patients in the prehospital setting.

Surgical interventions such as fasciotomy and amputation should also be considered in the prediction model to be created for CRUSH syndrome.

In the current unit were i am CK is not recognized as a marker of crush injury because it is not specific. Biocarb, PH and urine myoglobin are the only elements that are looked at. I would like to hear from other panel members about that. Thanks

Myorenal syndrome or myonephropathic syndrome can be classified as aerobic and anaerobic. Crush syndrome is an example of the aerobic type (e.g. after whipping; multiple crush injuries to muscles and soft tissues; no ischaemic component is present). The anaerobic type occurs when a limb has been ischaemic for several hours and is then reperfused (e.g. when a tourniquet has been on a leg and is then released, or when a leg has been entrapped under collapsed building rubble and is then freed). In both types, myoglobin is released into the circulation, with nephropathy to follow. However, in the anaerobic type, products of ischemia-reperfusion are also released into the circulation, which can cause multiple organ failure and death (sometimes very rapid death). It is important to distinguish between these two categories, and a single predictive model should not be used for both.

None

Thank you for the opportunity to participate - this is likely a topic with a lot of divide.

No additional suggestions

None.

-

Thank you for this interesting survey

End of Report