Burn Resuscitation
&
Burn Navigator®
Educational Background

Oct 2024

Clinical Goal of Burn Resuscitation

- Maintain adequate tissue perfusion at the least physiological cost of fluid[1]
  - Over-resuscitation complications
    - edema, increased risk of compartment syndromes, ARDS, mortality
  - Under-resuscitation complications
    - acute kidney injury, burn shock, organ failure, mortality

1 Rizzo, J., et al. "The Battle of the Titans–Comparing Resuscitation Between Five Major Burn Centers Using the Burn Navigator." Journal of Burn Care & Research (2022) https://doi.org/10.1093/jbcr/irac095

Clinical Goal of Burn Resuscitation

- Urine output is a good, but sometimes flawed, surrogate of tissue perfusion
  - If UO is high, reduce IV fluid rate
  - If UO is low, increase IV fluid rate

- UO may be flawed or skewed due to ESRD, renal insult, ethanol/alcohol abuse, meth/narcotic use, baseline diuretic, …

- Consider Hb/Hct, lactate, base excess, HR, BP, PPV in addition to UO

Burn Navigator's Features

1. **Implements <u>your</u> sophisticated resuscitation protocols**
   - Multiple fluids (LR, albumin, plasma …)
   - Customizable per patient (electrical, pediatric, …)

2. **Supports team communication**
   - Resuscitation graphs (volume, projections, trends, I/O)
   - Alerts for escalating to provider

3. **EMR documentation**

Burn Navigator

- is recommended for consideration by **ABA Clinical Practice Guidelines on Burn Shock Resuscitation**[1]
- provides reports for M&M, QI and CSV spreadsheet files for research
- is used by leading burn centers across the U.S. and internationally

1 Cartotto R, Johnson LS, et al., American Burn Association Clinical Practice Guidelines on Burn Shock Resuscitation, *Journal of Burn Care & Research*, 2024, Vol 45(3):565-589. https://doi.org/10.1093/jbcr/irad125

Multi-Center Clinical Data

Initial results of the American Burn Association Observational Multi-Center Evaluation on the Effectiveness of the Burn Navigator[1]

- Analyzed all patients (n=285) as well as two groups:
  - Followed Burn Navigator (FBN) if 83%+ of recommendations accepted
  - Or Not FBN (NFBN)
- FBN: average 4.07 mL/kg/TBSA and 151.48 mL/kg of primary fluids given in first 24 hours
- FBN: significant decrease in incidence of burn shock
- Early initiation of BN resulted in lower overall fluid volumes

1 Rizzo JA, Liu NT, Coates EC et al. Initial results of the American Burn Association Observational Multi-Center Evaluation on the Effectiveness of the Burn Navigator. *J Burn Care Res*. 2022, 43(3):728-34. https://doi.org/10.1093/jbcr/irab182

How does it work?

Initial Patient Questions

- Weight
- Confounders
- Choose Protocol
- TBSA%
- Time since burn
- Fluids & UO until now
- Initial rate recommendation

Fluid Updates (typically q1h)

- UO
- Primary resus fluid given
- Additional fluids given
- Safety questions (as needed)
- New recommendation

Always available

- Resuscitation graphs
- Safety alerts (as needed) & history

Protocol Limitation

- Currently, protocol options are urine-output based
- Consider if UO is *not* or *is no longer* a good surrogate for end organ tissue perfusion *for this patient*
- Consider Hb/Hct, lactate, base excess, HR, BP, PPV in addition to UO
- *We'd be glad to implement an advanced protocol with other variables. Please let us know details so we can add it.*

Volume Graph

1. Cumulative Volume

2. Ivy Index

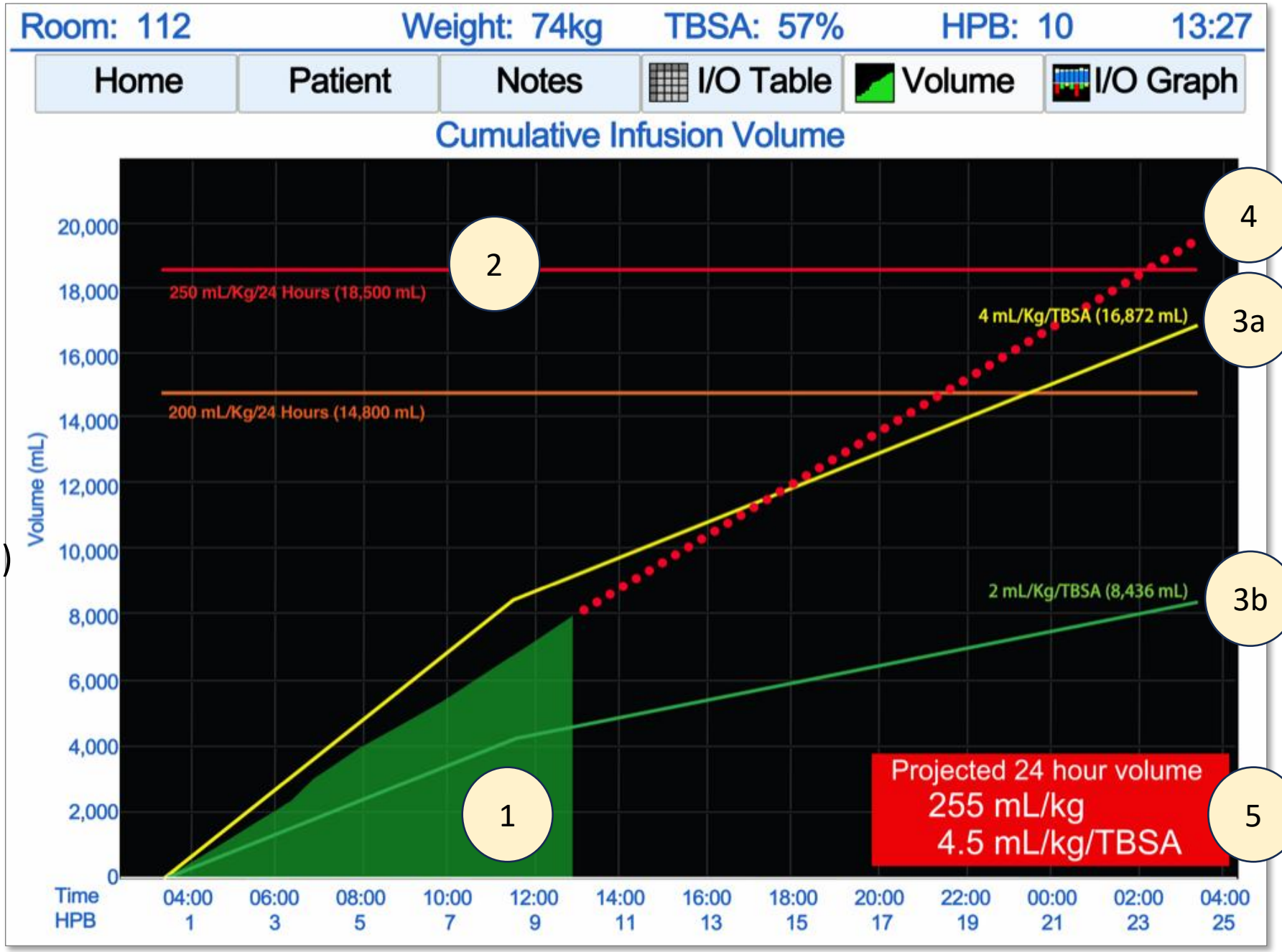
3. Guidelines

a. 4mL/kg/TBSA (Parkland)

b. 2mL/kg/TBSA (Mod Brooke)

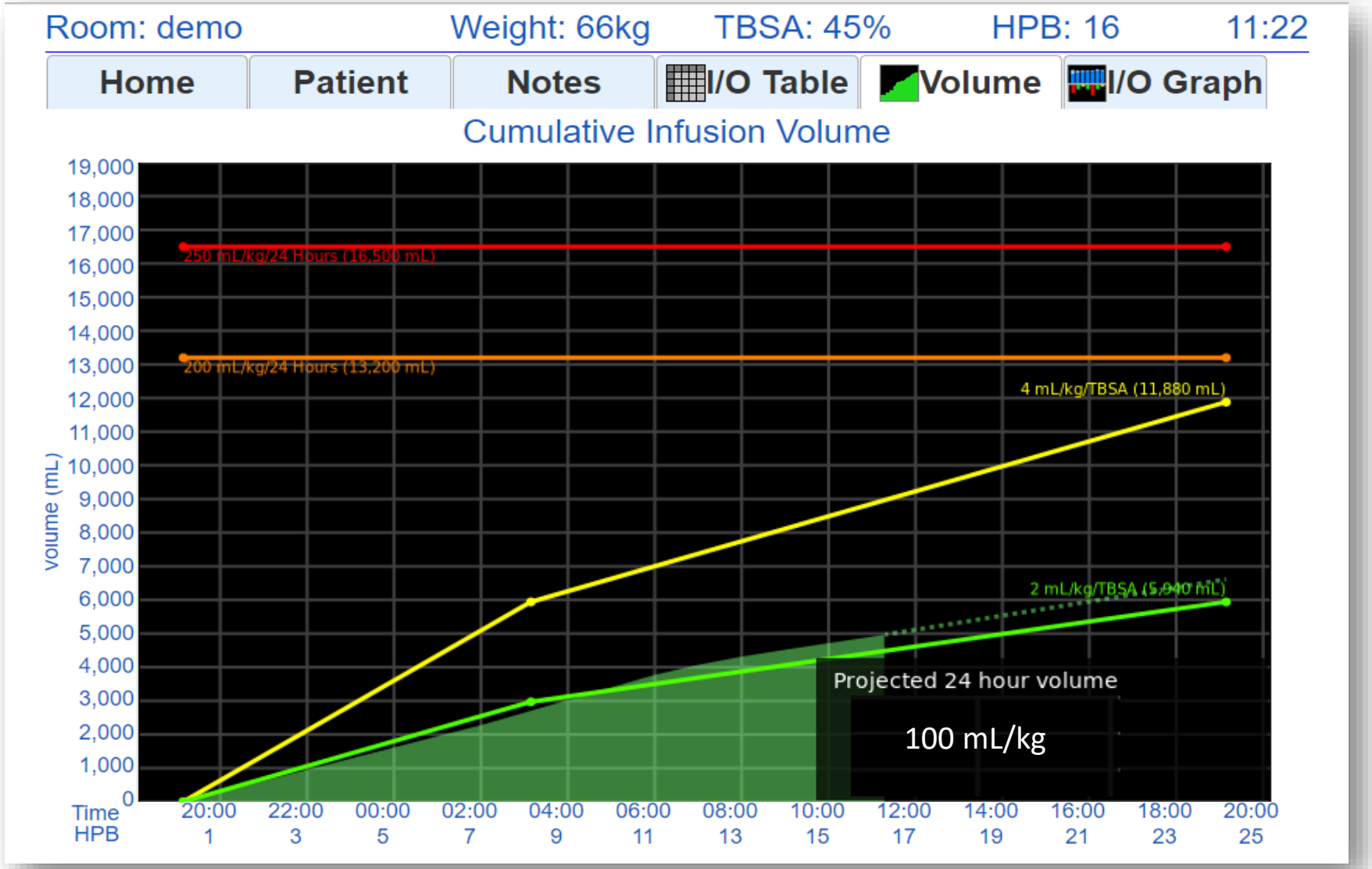
4. Projection Line

5. Projected 24-hour volume



Example

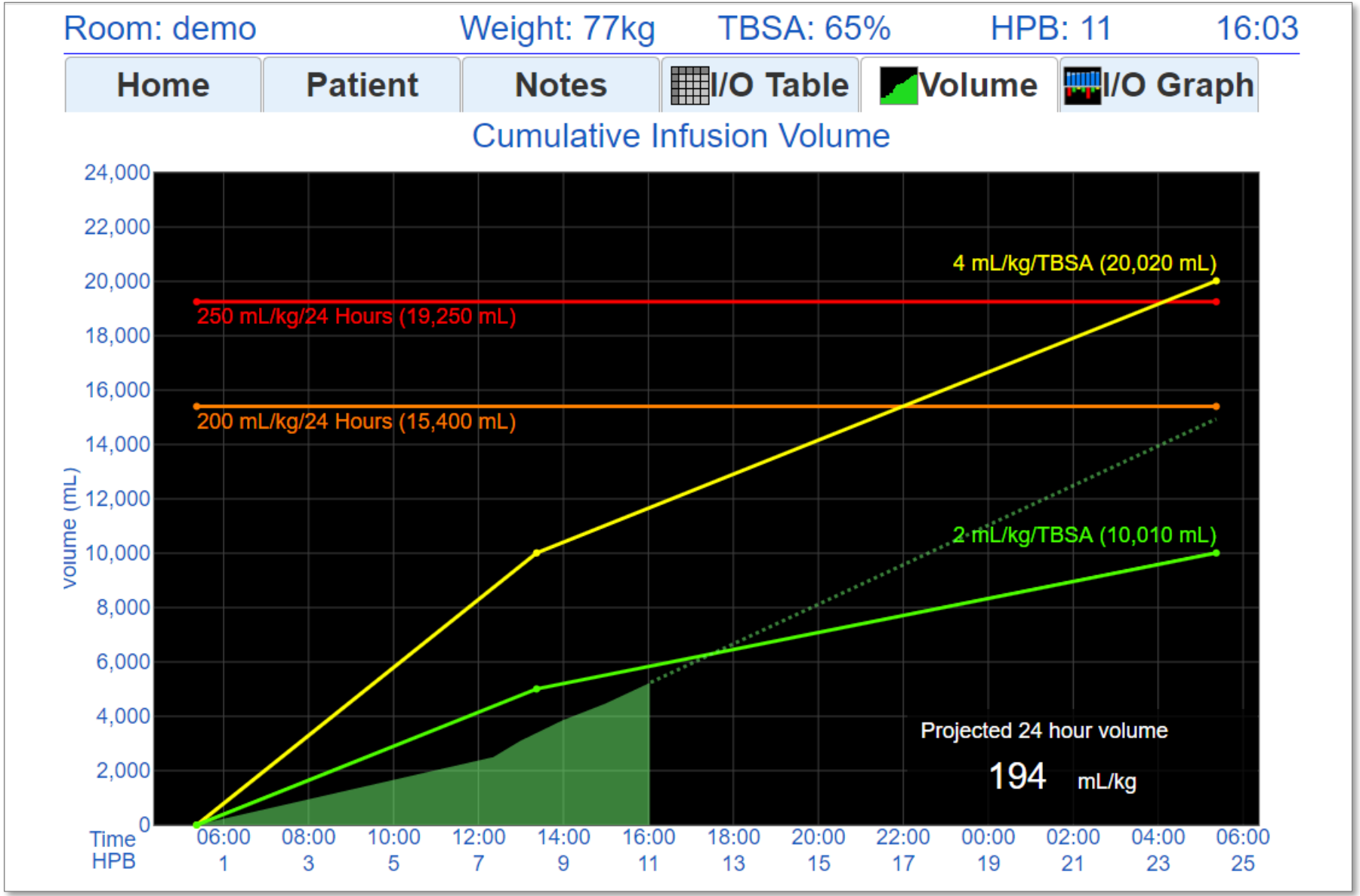
If UO/tissue perfusion is adequate, this volume of fluids is sufficient



Example

Likely under-resuscitated pre-hospital

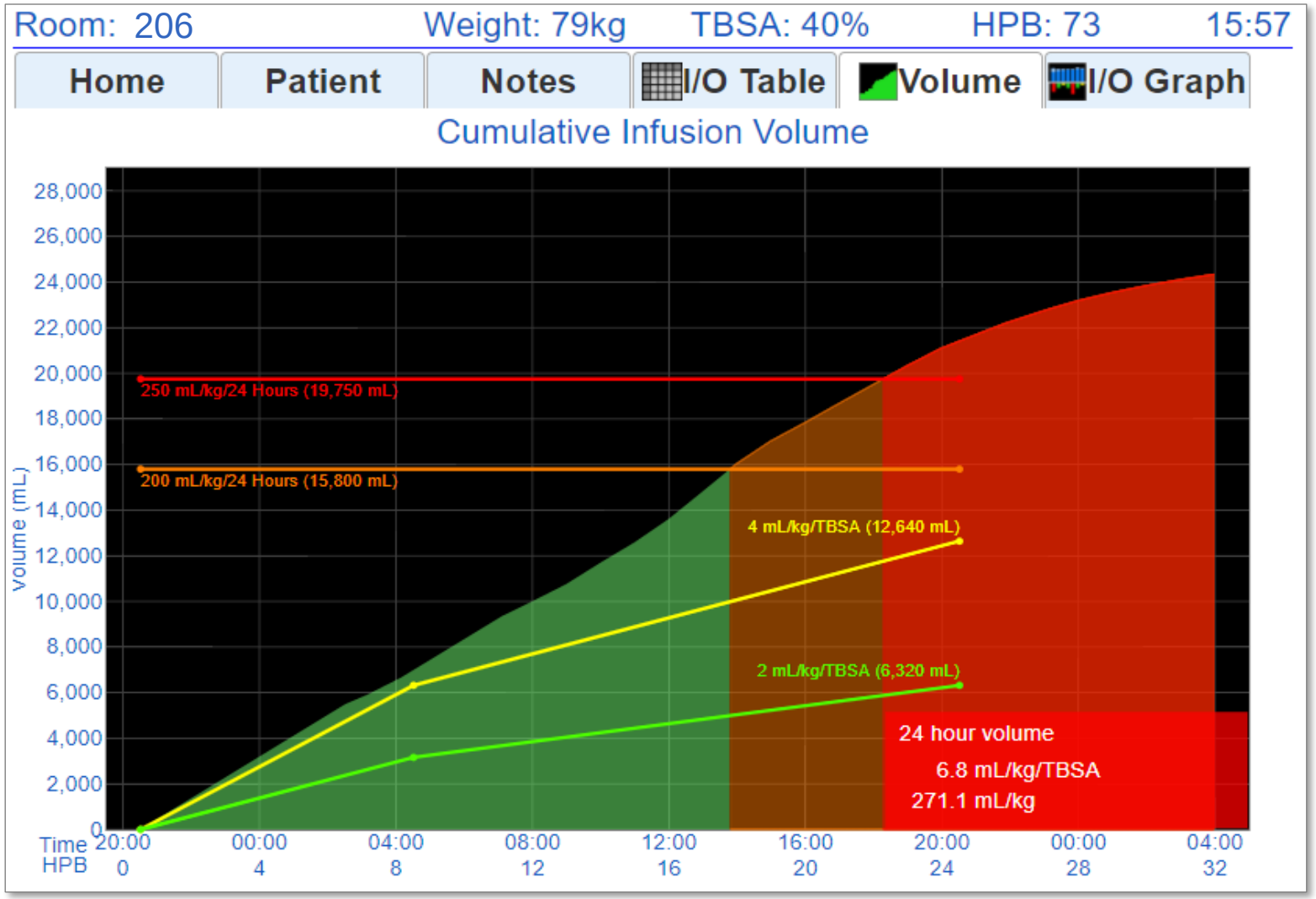
Resuscitation more on track now



Example

Likely over-resuscitated

UO did not respond to increasing IV fluid rates, IV fluid was not turned down soon enough

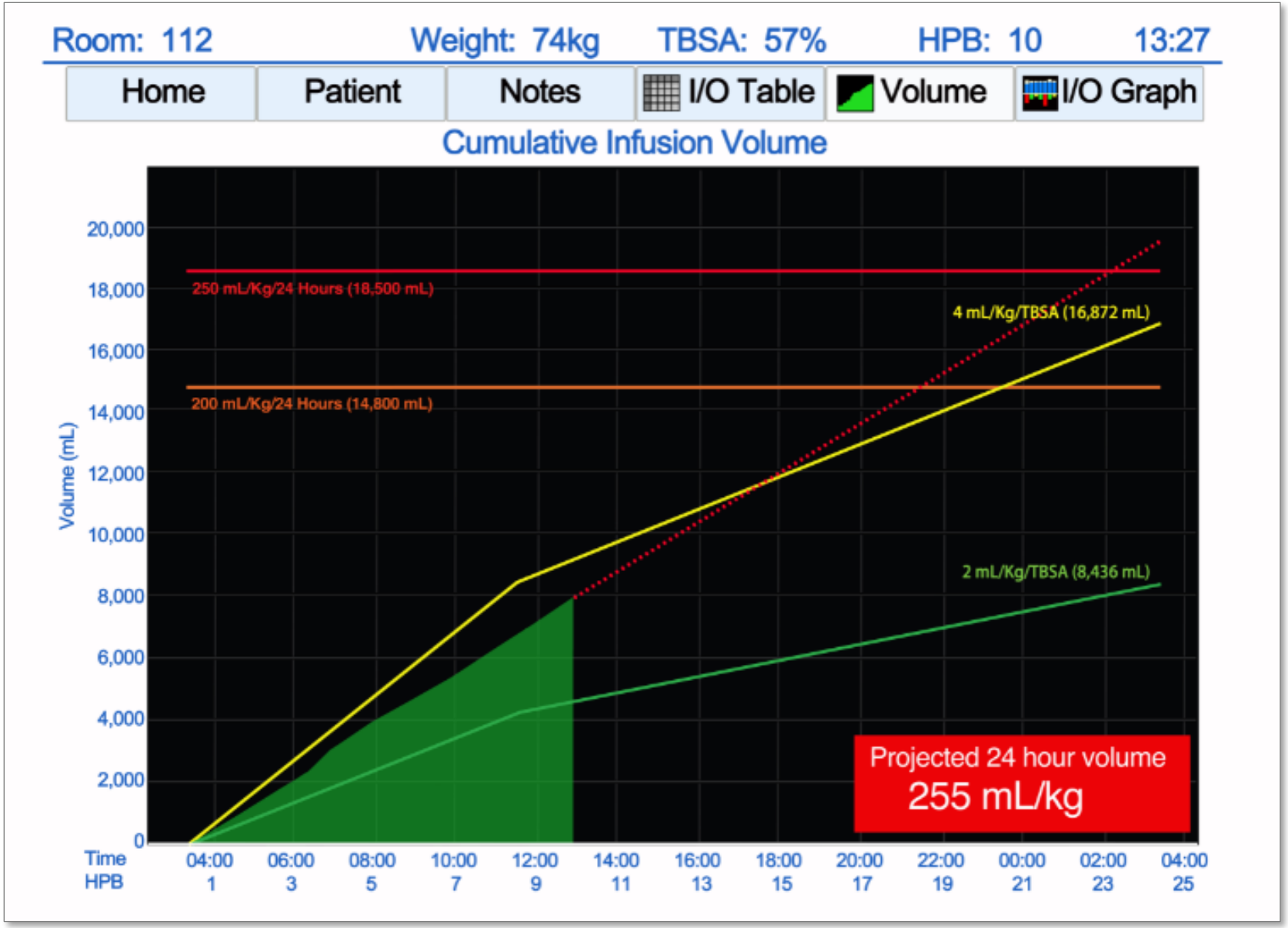


Example

Resuscitation going well so far, but projection exceeds Ivy Index

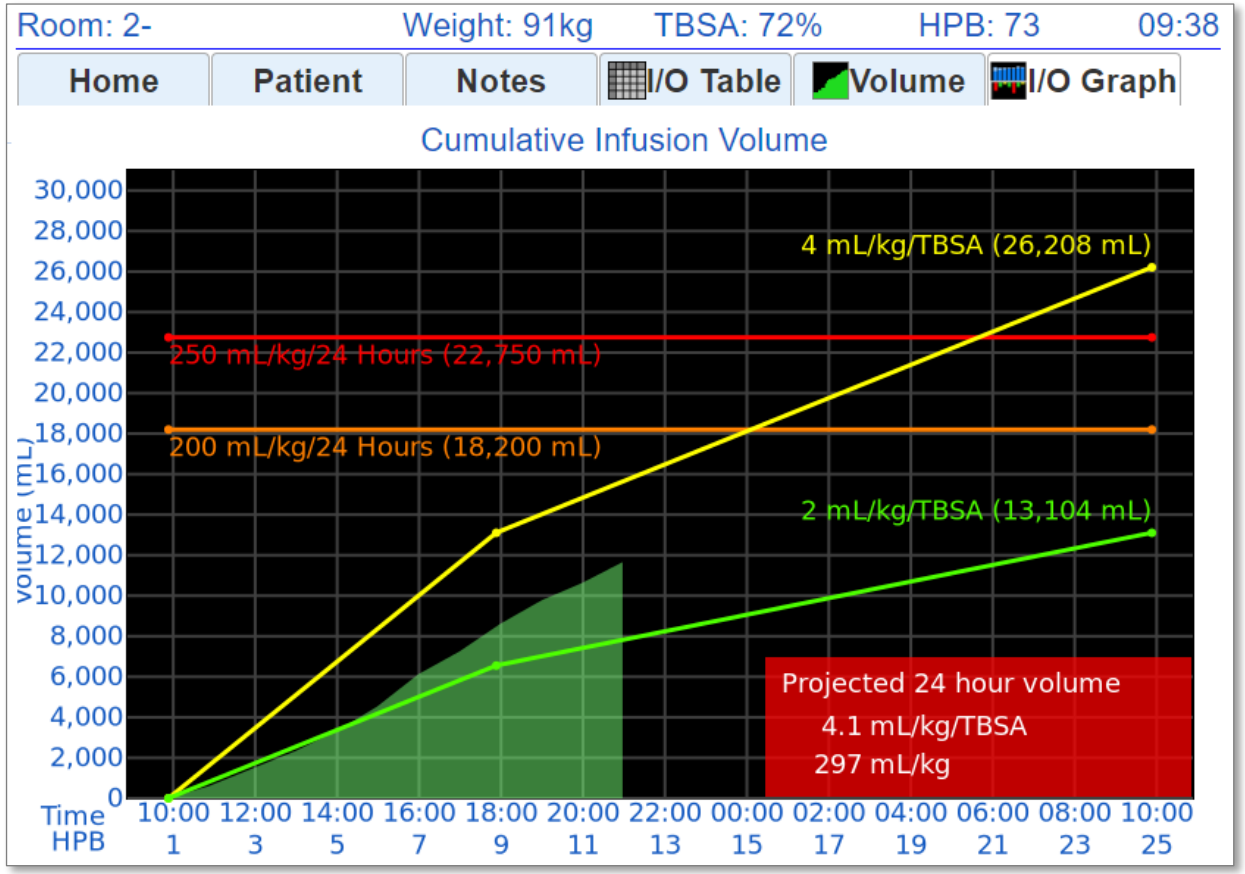
Projection shows by HPB 10

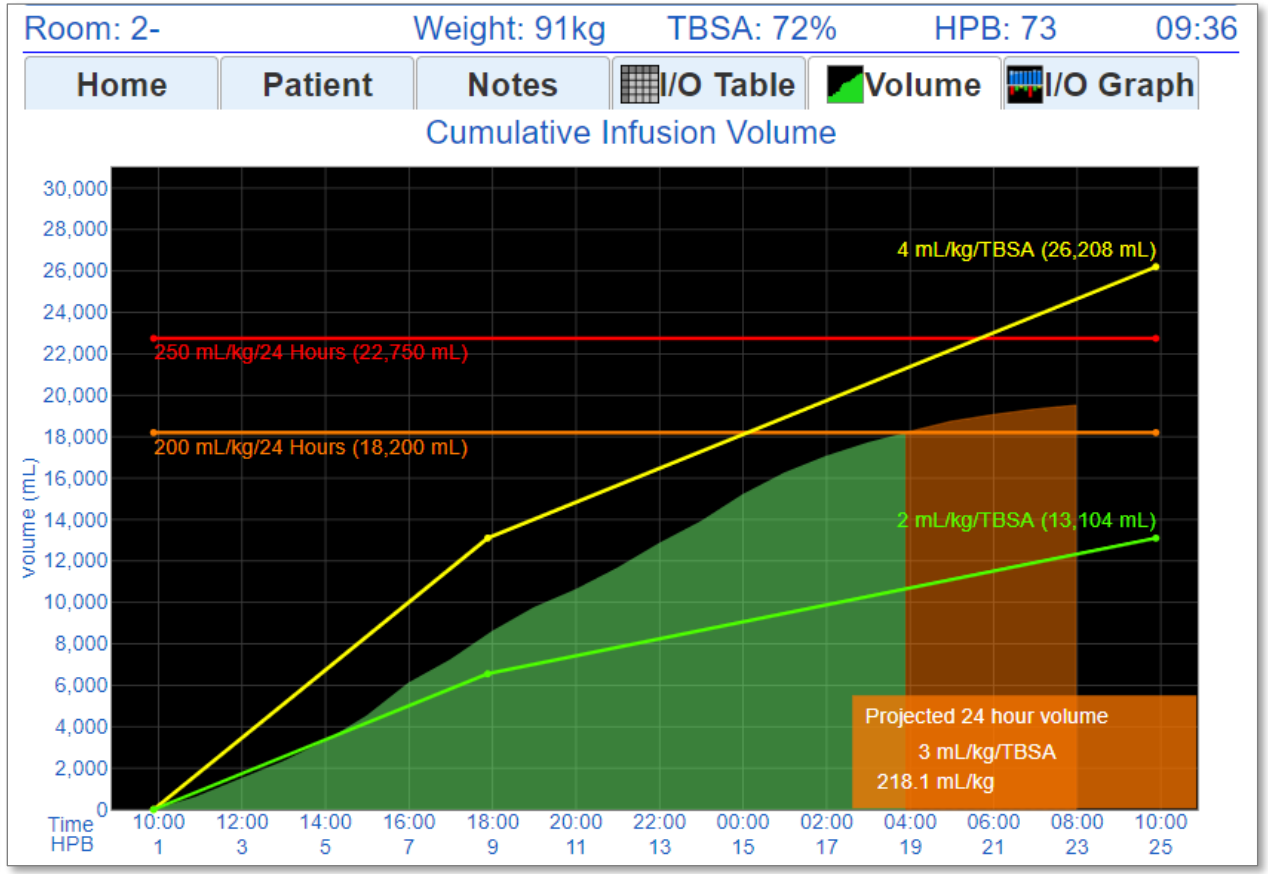
- Consult attending physician if projection exceeds Ivy Index (250mL/kg)



Example

Timely interventions can result in good resuscitations, even for large (70%+ TBSA) burns





I/O Graph

1. Primary Resuscitation Fluid(s) *dark blue*

The fluid(s) titrate per protocol, e.g., LR or 2/3 LR + 1/3 plasma

2. Additional Fluids

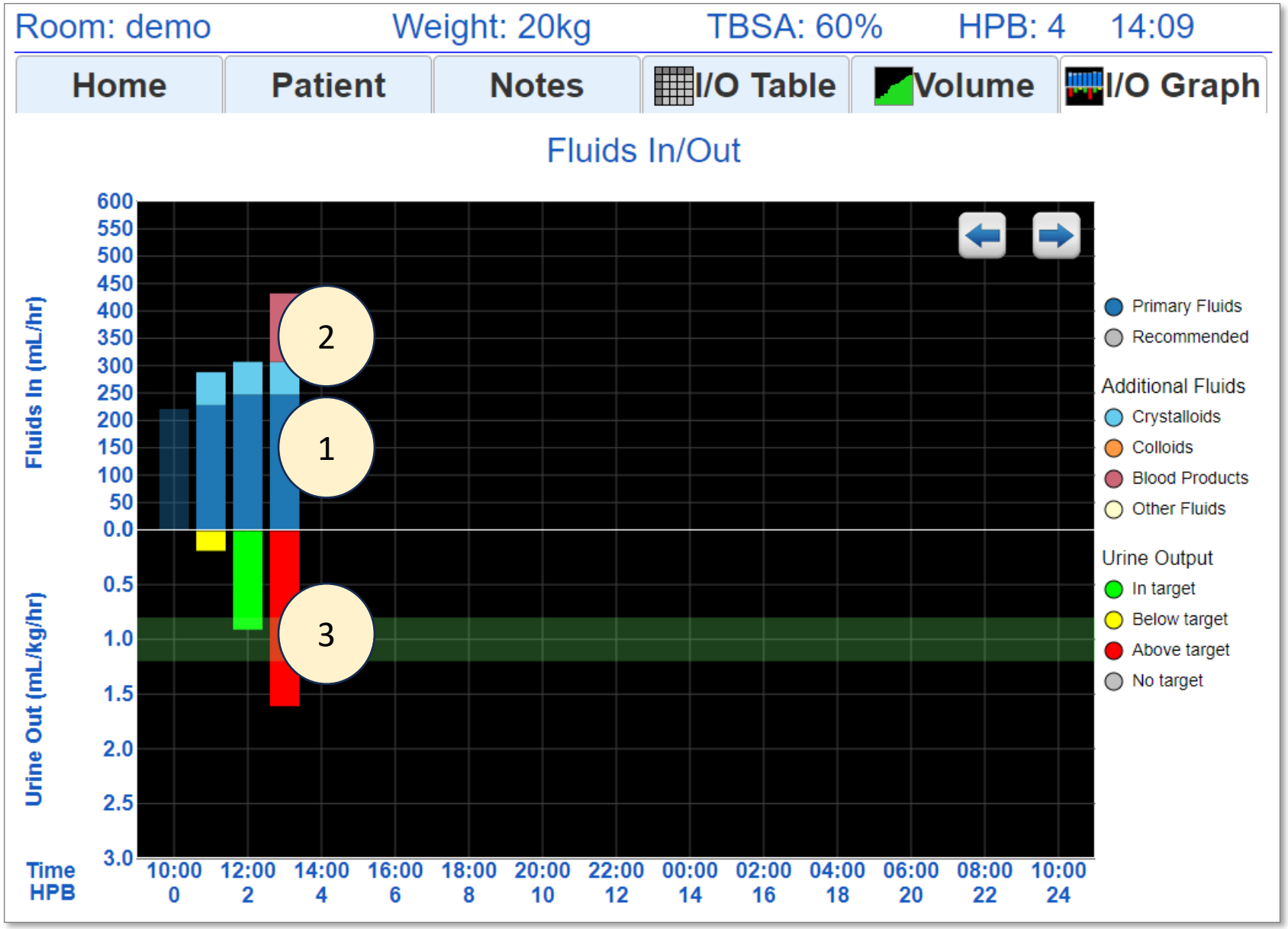
E.g., plasma, albumin, …

3. Urine Output

Green: In Target

Yellow: Below Target

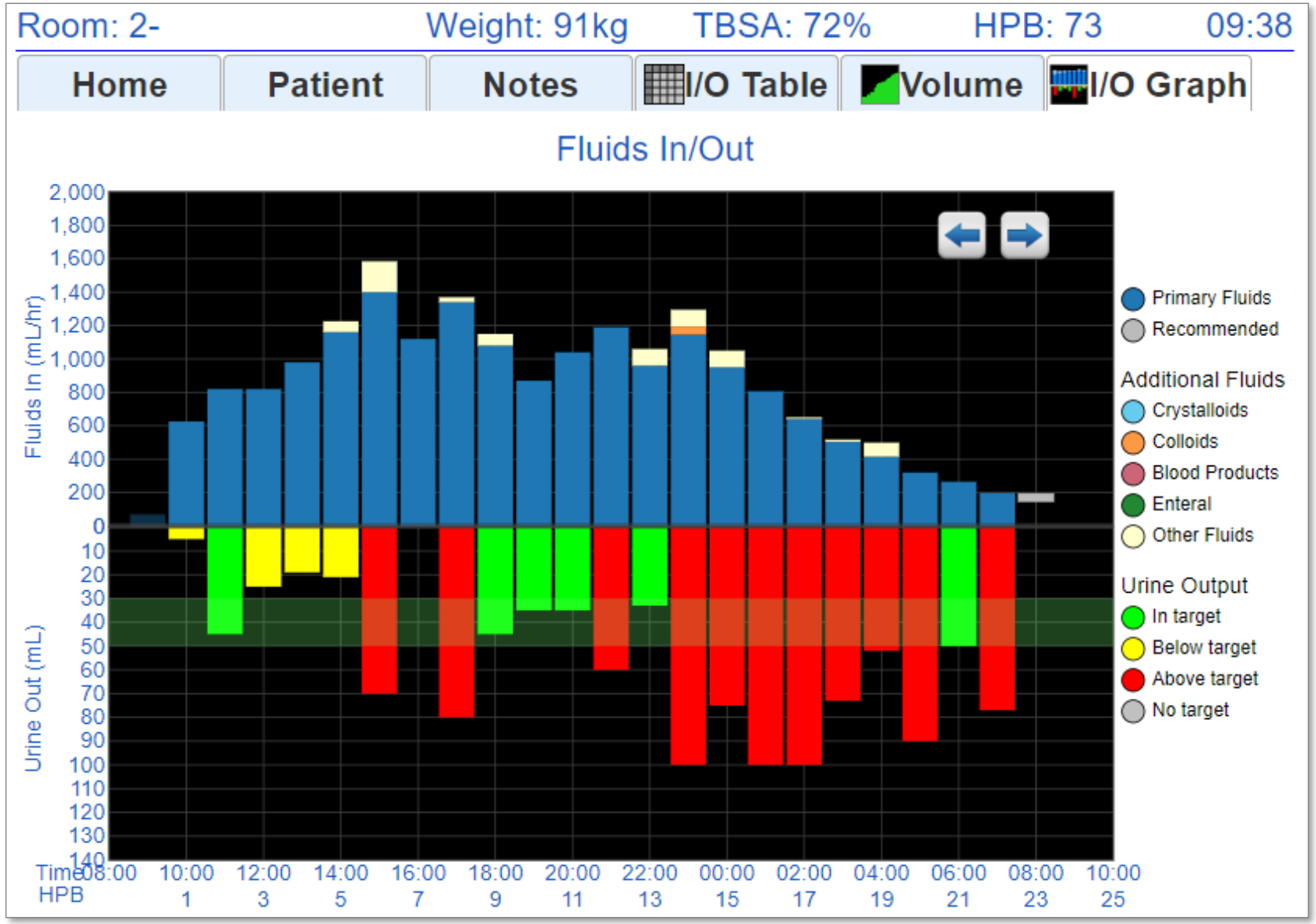
Red: Above Target



Example

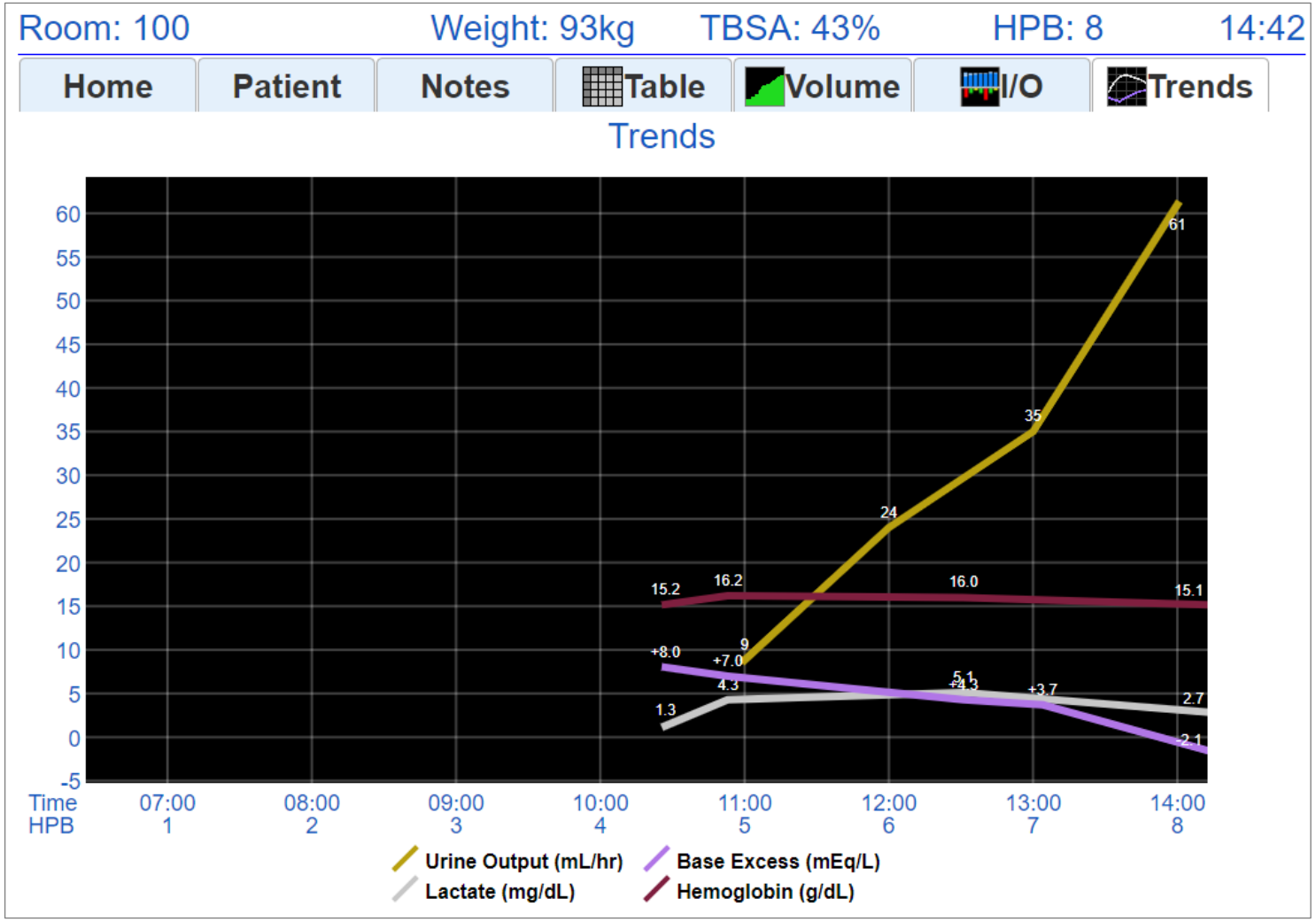
72% burn,

a good resuscitation



Trends Graph

- View lab data trends to support resuscitation decisions
- Lab data can be imported from the EMR automatically



Safety Alerts (examples)

Alert!

24 hour projection is 265 mL/kg. Review the Volume and I/O graphs. Consult with attending physician. Consider monitoring bladder pressure, albumin or other intervention.

Alert! Consult with attending physician about an appropriate fluid rate during presence of hypotension, hyperglycemia, pressors or diuretics.

Alert!

Urinary output is not responding to fluid therapy. Check Foley catheter for obstruction and check bladder pressure. Patient may be a fluid “non-responder". Contact attending physician.

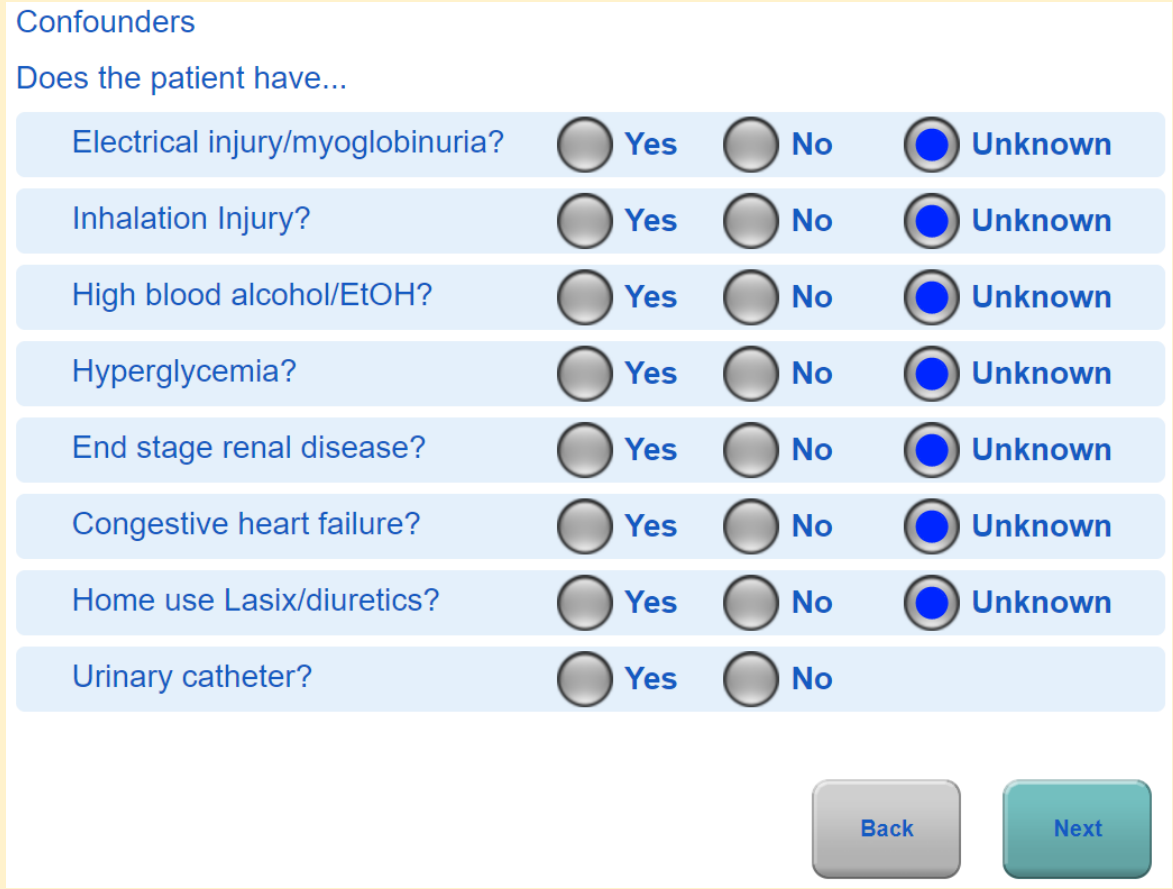
EMR Integration

- Burn Navigator can send all the data from the hourly fluid updates to the EMR
  - UO
  - Recommended rate
  - Actual volume
  - Additional fluids
  - Safety question answers

- Burn Nav can also be configured to receive data from EMR
  - Lab values (lactate, BE, Hb)
  - Vital signs

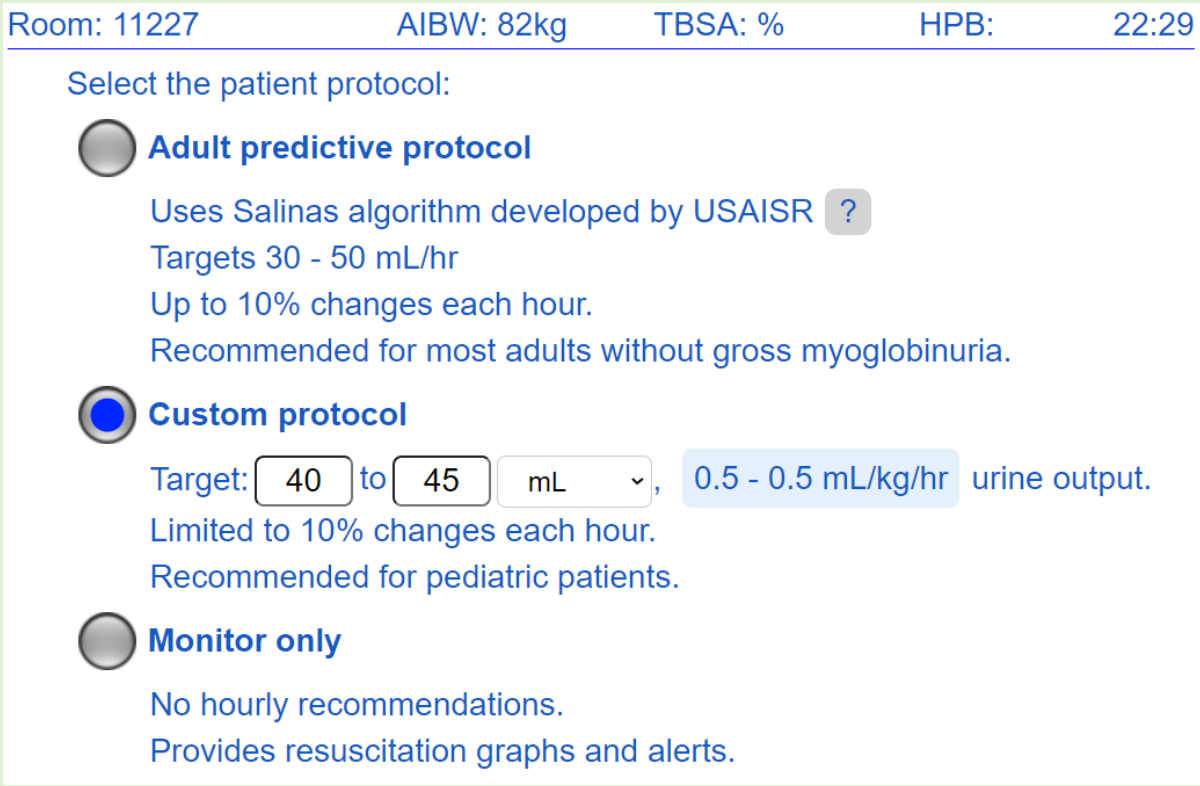
Actual Times	13:03	14:00	15:00	16:00	17:00	18:00	19:00	20:00	(21:00)
Urinary Output (mL)	150	250	50	60	65	45	40	25	
Urinary Output (mL/kg/hr)	0.5	3.3	0.6	0.8	0.8	0.6	0.5	0.3	
Recommended Rate (mL/hr)		1,050	900	770	880	750	750	850	880
Actual Primary Rate (mL/hr)	500	1,050	900	770	880	750	750	850	
Actual Primary Volume (mL)	2,000	998	900	770	880	750	750	850	
Lactated Ringer's (mL)	2,000	998	900	770	880	750	750	850	
Total Secondary Fluids (mL)			50					150	
Plasma-lyte (mL)			50						
25% Albumin (mL)								150	
Total Other Fluids (mL)				250	350	250	250	250	
IV Medications (mL)				250	250	250	250	250	
Tube Feeds (mL)					100				
Total Fluids In (mL)	2,000	998	950	1,020	1,230	1,000	1,000	1,250	
Total Cumulative Fluids (mL)	2,000	2,998	3,948	4,968	6,198	7,198	8,198	9,448	
Hypotensive		No	No		No				
Hyperglycemic		No	No		No				
On Pressors		No	No		No				
On Diuretics		No	No		No				

Confounders



Talk with provider about the appropriate UO target if there are confounders

Provider Chooses Protocol



1. **Adult predictive** dynamic adjustments developed by U.S. Army Burn Center
2. **Custom** allows you to choose target UO range, either in mL or mL/kg (for peds or electrical)
3. **Monitor Only** if UO is not a good resuscitation indicator, e.g., renal failure, diuretics

Fluid Updates

1 Urine Output + Current Rate

Room: Training | Weight: 80kg | TBSA: 80% | HPB: 10 | 12:01

Fluid Update: Urine Data

Urine measurement time

From:11:23 | To: 12:00 | 37 mins

Urine output volume

3 mL | 0.1 mL/kg/hr

☐ Urine output is not measured or unknown

Back | Next

Room: Training | Weight: 80kg | TBSA: 80% | HPB: 10 | 12:01

Fluids Given

From:11:23 | To:12:00 | 37 mins

Primary fluid was:

Lactated Ringer's

Current infusion rate: 600 mL/hr

Total infused volume: 370 mL

Back | Next

2 Additional Fluids

Additional Fluids

Legend: Crystalloids | Colloids | Blood Products | Other

	Fluid	Volume	Repeat
X	Albumin 5%	70 mL	☑
X	Plasma	250 mL	☐

Select a fluid type...

Total Additional Fluids: 320 mL

3 Safety Questions (for decrease)

Safety Questions

Is patient hypotensive?	● Yes	○ No
Is patient hyperglycemic?	○ Yes	● No
Is patient on pressors?	○ Yes	● No
Is patient on diuretics?	○ Yes	● No

4 New rate!

New Rate

Previous infusion rate: 600 mL/hr

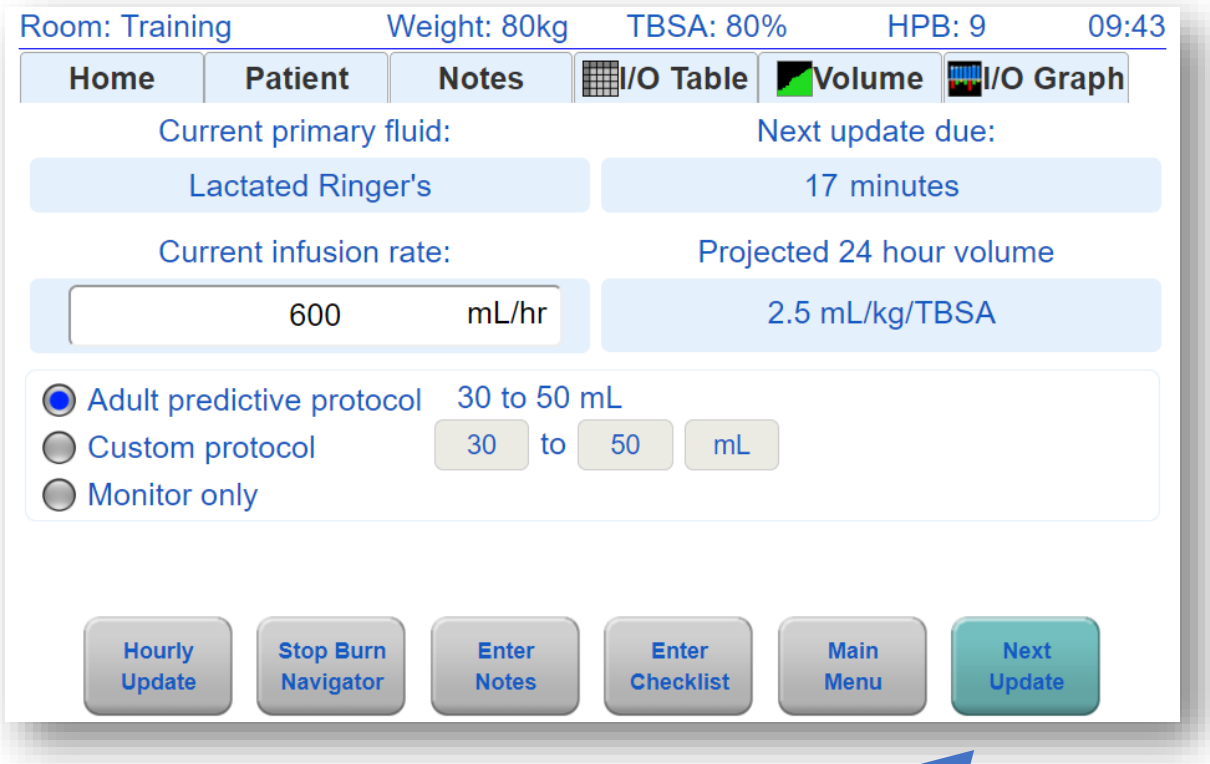
Fluid type: Lactated Ringer's

Recommended rate: 660 mL/hr ▲ 10 %

New rate: 660 mL/hr ▲ 10 %

Practice at https://us.burnnav.net/demo

Choose “Training Mode”



In **“Training Mode”** only: Press “Next Update” to fast-forward time

Indications For Use (Detailed)

- The Burn Navigator is indicated for use in the care of adult patients with 20% or more Total Body Surface Area (TBSA) burned, or pediatric patients, 24 months old or older, weighing at least 10 kg with 15% or more TBSA burned, as a fluid resuscitation monitor and calculator for hourly fluid recommendations.
- The Burn Navigator is intended to be used for burn patients of all ages, weights and co-morbidities as a fluid resuscitation monitor.
- The Burn Navigator is intended to be initiated within 24 hours of the burn incident and to be used no longer than 72 hours post burn.

Keep in Mind!

Recommendations are only recommendations!

Understand the whole clinical picture, communicate with the attending physician, and do what's best for the patient

As a software tool, Burn Navigator is not intended to replace clinical decision judgement, rather it informs clinical decision making.

Users should always rely on their clinical judgment when making decision regarding patient care. The Burn Navigator recommendations are not a substitute for clinical judgment.

Arcos™

Burn Navigator®

Please contact us with any questions or feedback!

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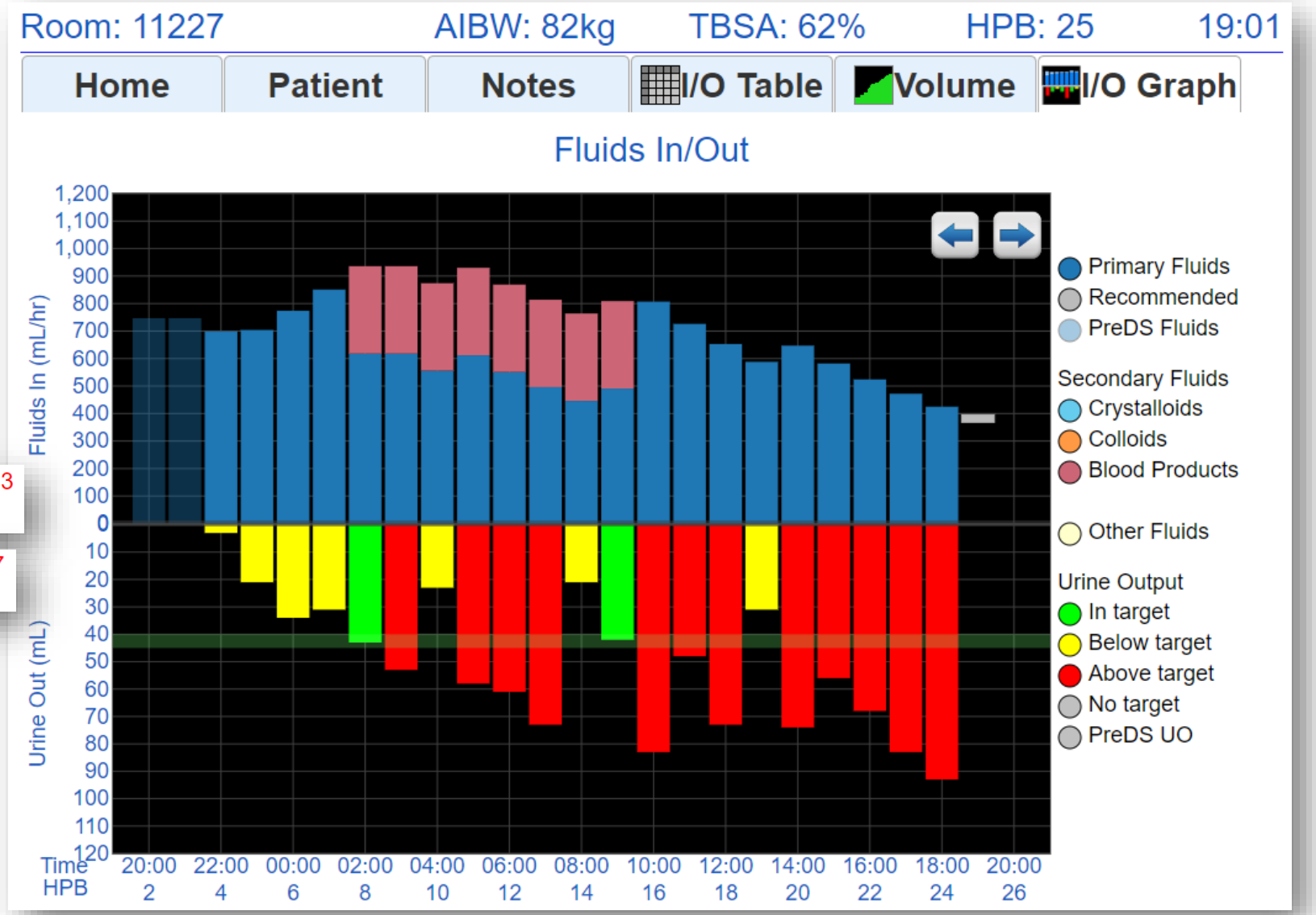
Extra Slides

Custom protocol examples

Plasma protocol

Ask Provider: Start Plasma at 207 mL/hr; reduce primary fluid to 313 mL/hr?

Ask Provider: After Plasma completed, increase primary fluid by 207 mL/hr to 483 mL/hr?



Research protocol

PROPOLIS study: 1 mL/kg/TBSA/24 = 165 mL/hr of PRP or additional LR

Many customization options