Feedback and Constraints: Medication Safety Strategies

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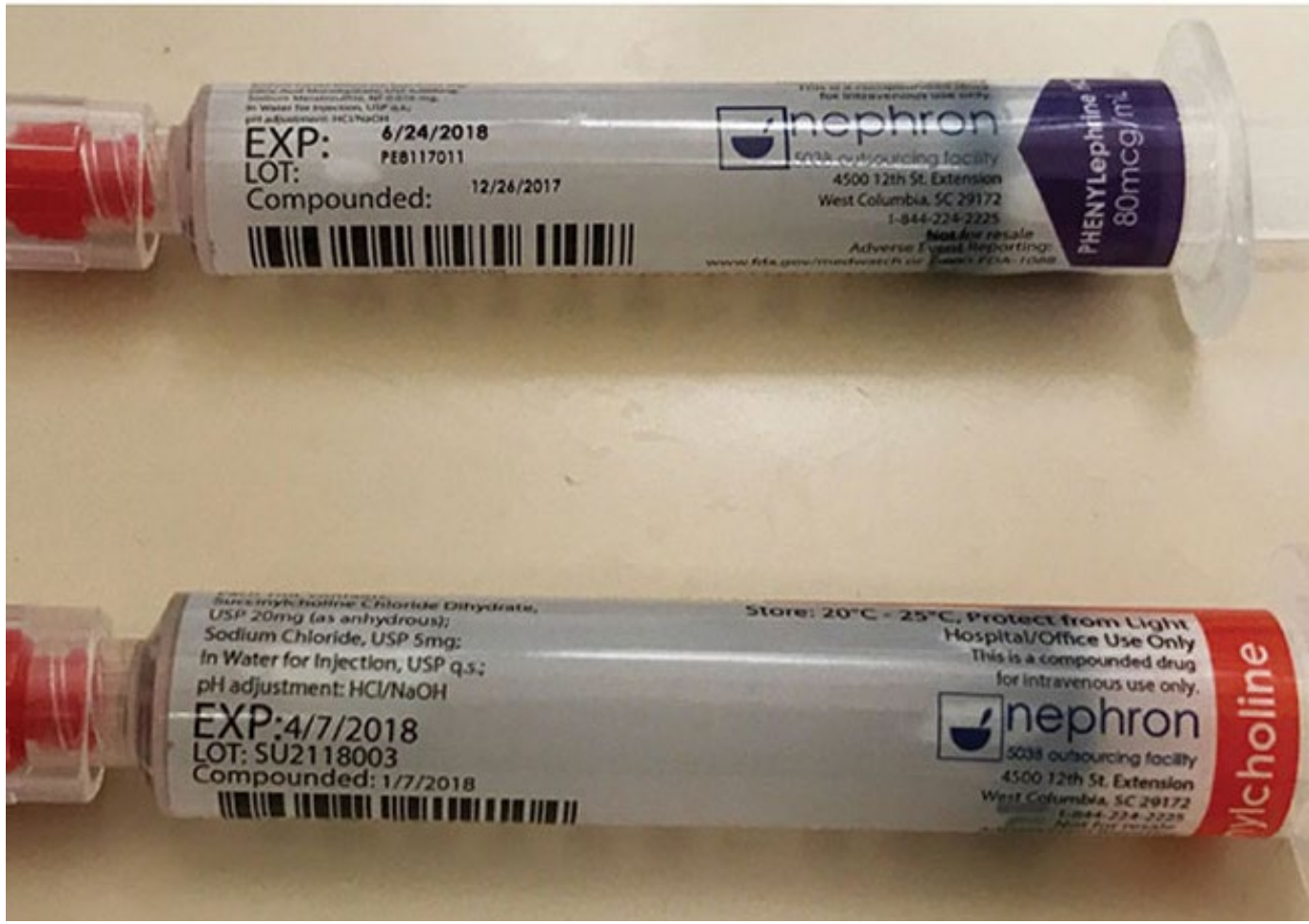
http://scotsimcentre.blogspot.com/2015/05/affordances-and-constraints.html

Current State

- Anesthesia medication handling is complex
- Numerous single point failures
- Reliant on accuracy and vigilance

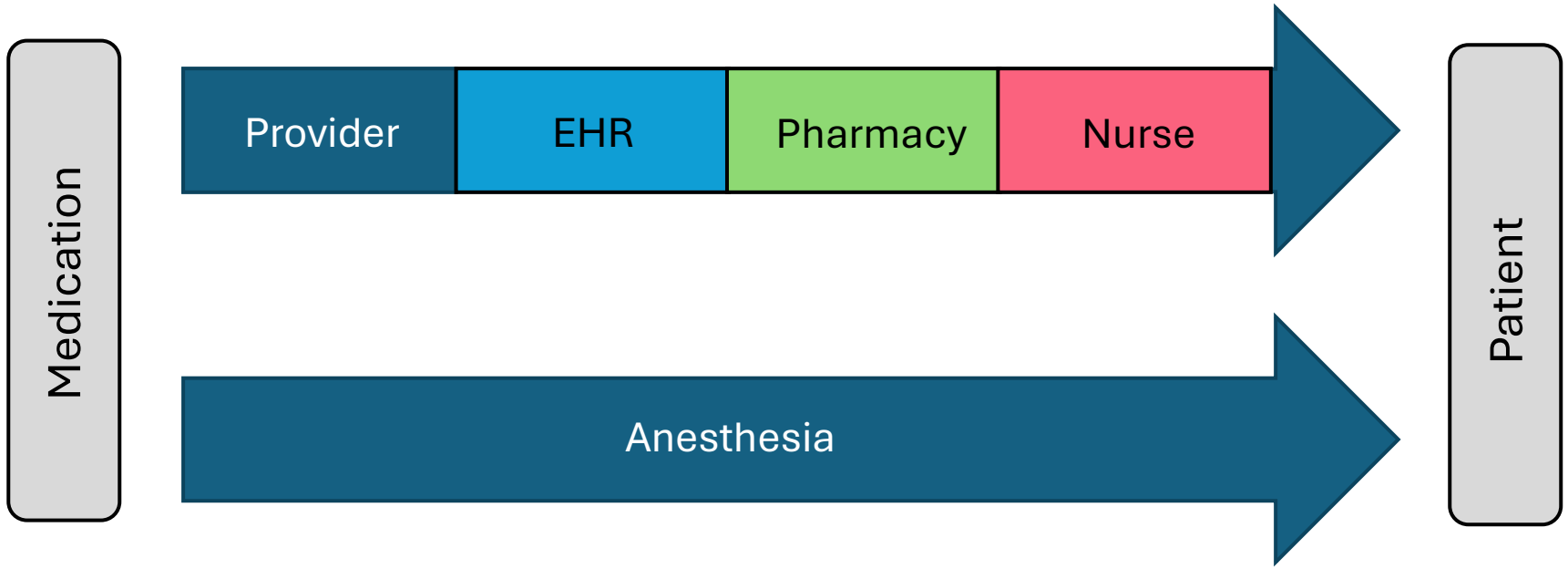
- Countermeasures are not sustainable
  - Labels: focus, standardization, no physical prevention
- Wahr et al: 138 medication safety recommendations

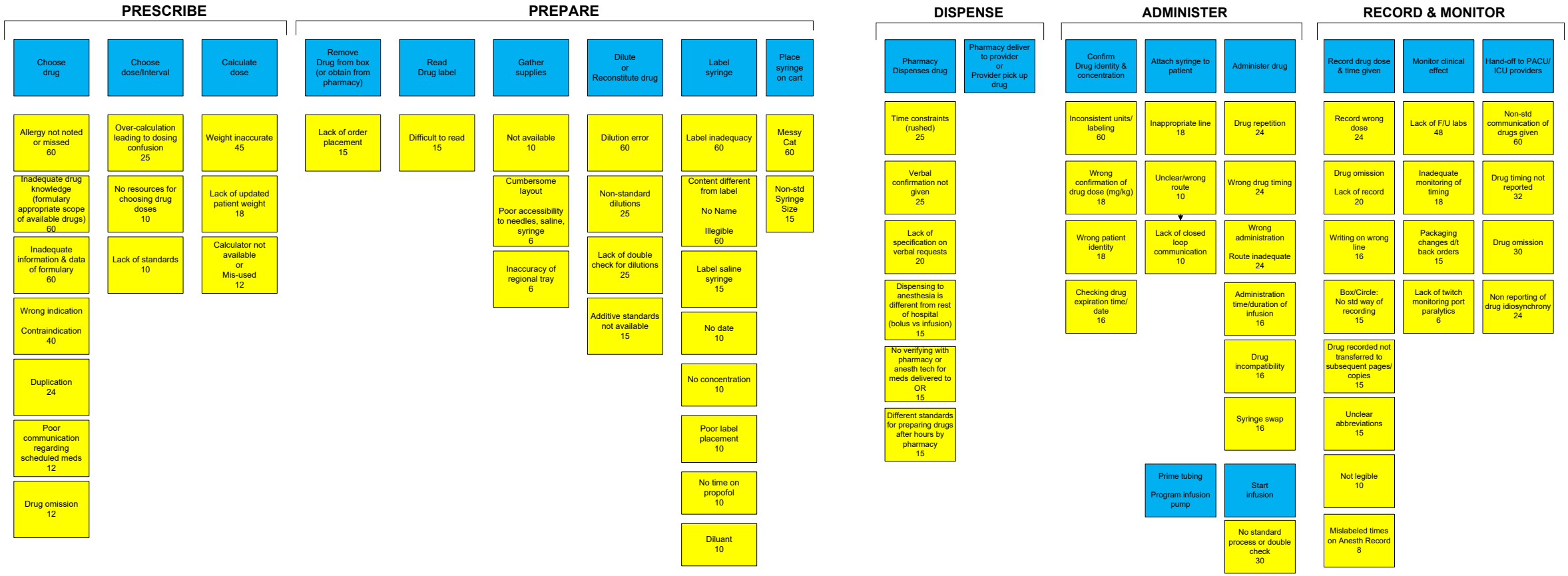


Wahr JA et al. Br J of Anaesth 2017;118(1):32-43.


STOP
The first stop signs were white squares with black letters.
Source: Brain Stuff, New York Times

Countermeasures v. Fragmentation

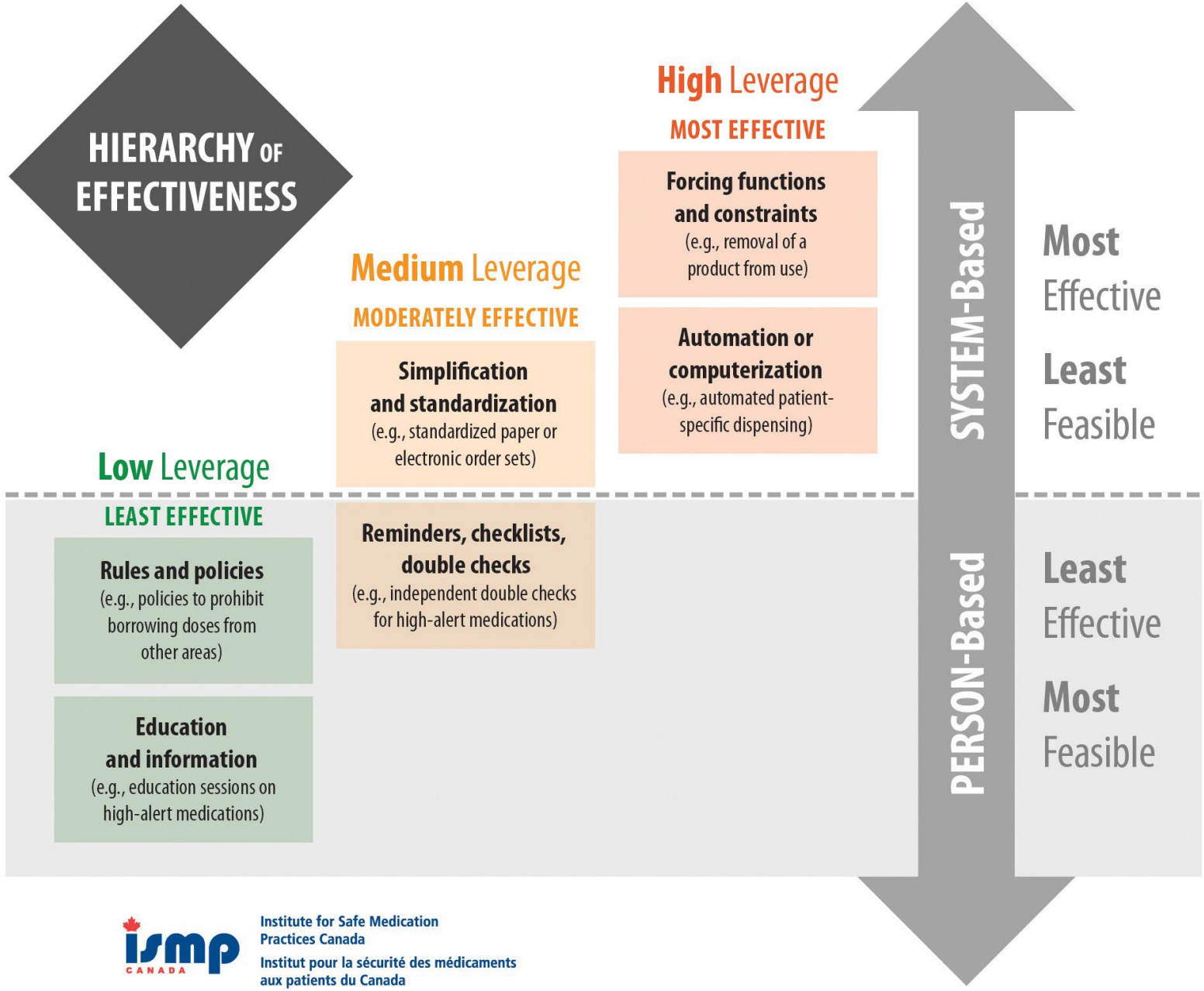




Failure Mode and Effects Analysis

- 5 Steps
- 19 Sub-steps (blue)
- 68 Possible failure modes (yellow)

Martin et al. Pediatr Anesth 27(6): 571-580, 2017.

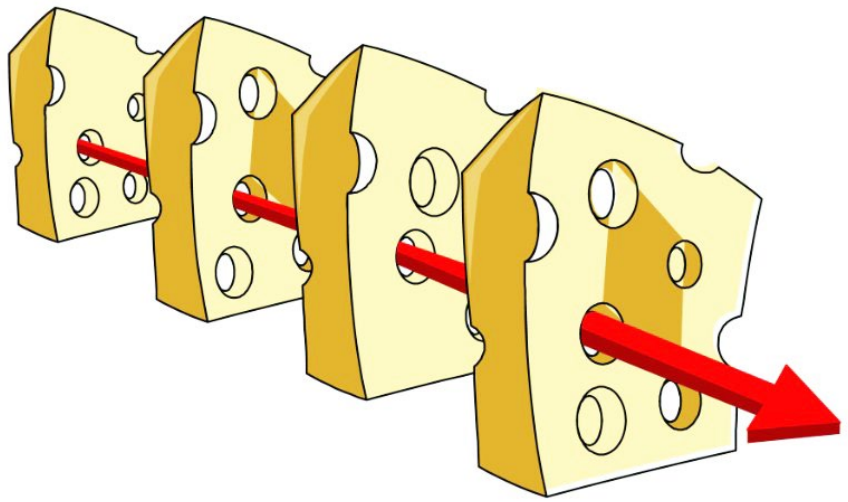

HIERARCHY OF EFFECTIVENESS
High Leverage
MOST EFFECTIVE
Forcing functions and constraints
(e.g., removal of a product from use)
Automation or computerization
(e.g., automated patient-specific dispensing)
Medium Leverage
MODERATELY EFFECTIVE
Simplification and standardization
(e.g., standardized paper or electronic order sets)
Low Leverage
LEAST EFFECTIVE
Reminders, checklists, double checks
(e.g., independent double checks for high-alert medications)
Rules and policies
(e.g., policies to prohibit borrowing doses from other areas)
Education and information
(e.g., education sessions on high-alert medications)
SYSTEM-Based
PERSON-Based
Most Effective
Least Feasible
Least Effective
Most Feasible
ismp CANADA
Institute for Safe Medication Practices Canada
Institut pour la sécurité des médicaments aux patients du Canada

Anesthesia Safety Tools

Left (Medication) Side	Right (Machine) Side
No Dose Checking	Color-Coded Gases / Lines
No Alarms	Diameter and Pin-Index Safety Systems
No Way to Detect Errors	Oxygen-Nitrous Coupler
No "Exhaled" Propofol Monitor	Gas Monitors and Alarms
	Pressure and Flow Sensors and Alarms
	Keyed and Colored Vaporizer Fillers
	Patient Monitors: SpO_2, $ETCO_2$
	Flow Meter Assembly Order
	Oxygen Pressure Failure Device
	Vaporizer Transport Setting
	Machine Check

Grigg and Roesler. Anesth Analg 126(1): 346-50, 2018.

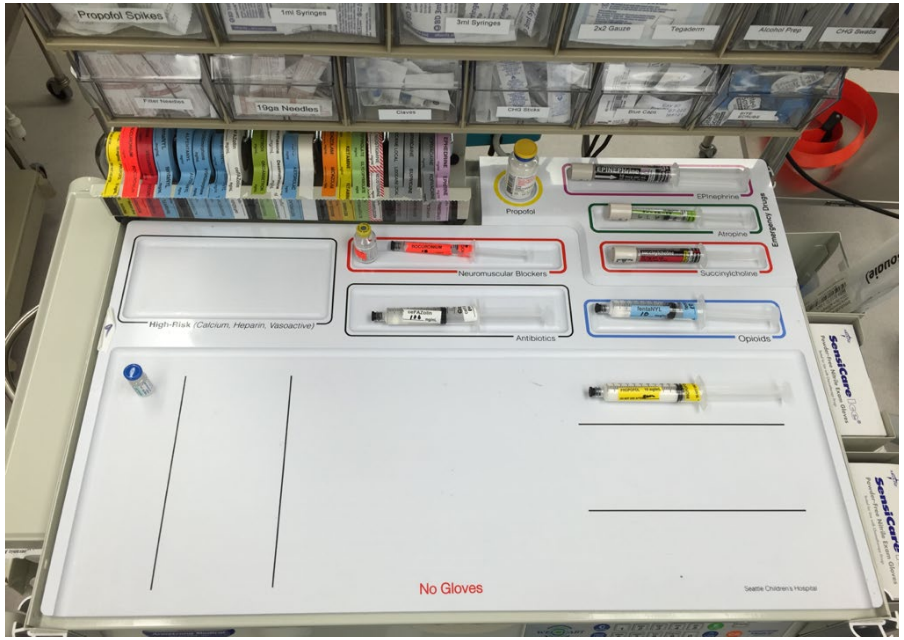
Feedback v. Constraints



- Feedback: requires compliance and engagement
- Constraints: eliminate steps, automate processes, physically prevent mistakes

Feedback	Constraints
Color-coded syringes	Smart pump guardrails
Barcode scanners	Standard pharmacy concentrations
Labels	Prefilled syringes
Two-provider checks / Checklists	Standard layouts
Alarms	(Machine examples…)

Grigg and Litman. BJA 121(6):1188-90, 2018.


Propofol Spikes
1ml Syringes
3ml Syringes
2x2 Gauze
Tegaderm
Alcohol Prep
CHG Swabs
19ga Needles
Propofol
EPInephrine
Atropine
Emergency Drugs
Neuromuscular Blockers
Succinylcholine
High-Risk (Calcium, Heparin, Vasoactive)
Antibiotics
Opioids
No Gloves
Seattle Children's Hospital


B BRAUN
propofol
50
mcg/kg/min
Rate: 21ml/h
Perfusor Space

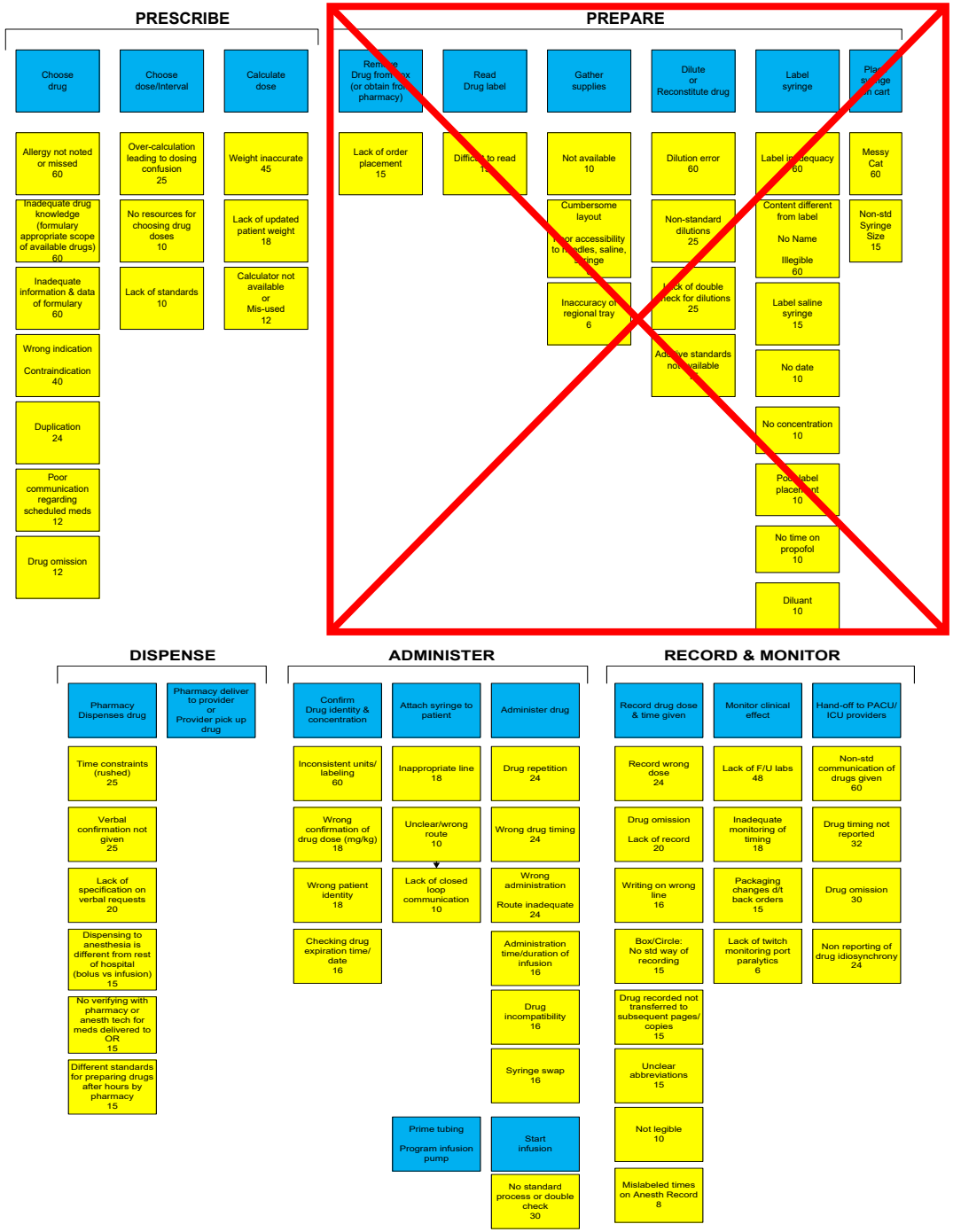

rocuronium 50 mg/5 mL
neostigmine 5 mg/5 mL
ketamine 50 mg/5 mL
in 0.9% sodium chloride
ePHEDrine 50 mg/5 mL
in 0.9% sodium chloride
glycopyrrolate 1 mg/5 mL

Additive Interventions

- Inspired by reporting systems or RCAs
- The “TSA” problem
- Layered on top of existing workflows

Subtractive Interventions

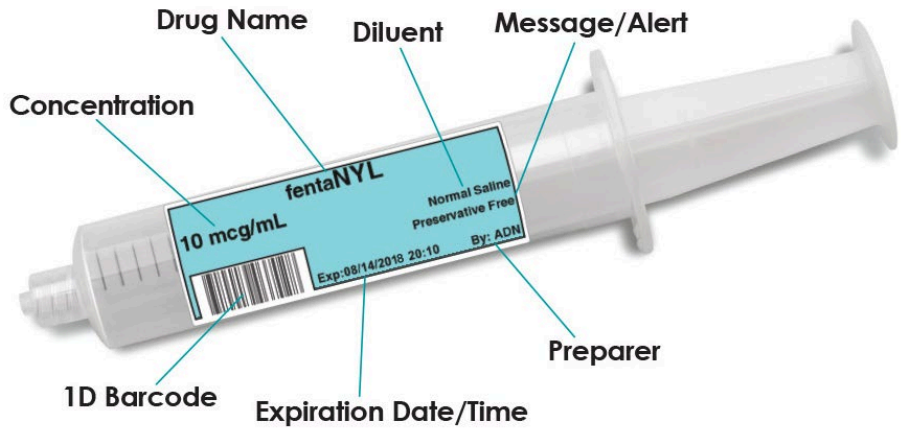
- Adding countermeasures v. Subtracting failure points
- Pre-filled syringes eliminates *Preparation* step
  - 6 Sub-steps
  - 19 Failure modes



Paved With Good Intentions

- Transplanted ideas → double-check, barcoding
- Solving adjacent problem → automated dispensing carts
- Unsolvable root problem → look-alike vials
- Overshadowed by others → anti-color-coding, pre-filled syringes

- Why don’t we barcode scan sevoflurane?



Subtractive Questions

- How to eliminate…
  …vials?
  …syringes?
  …labels?
  …mental calculation?
  …interoperability issues?
- How to automate…
  …drug selection?
  …concentrations?
  …recording?
  …interaction detection?
  …?

Constrain to Afford

- Today: process design reduces errors
  - Simplify
  - Standardize
  - Constraints
- Tomorrow: exploit unique workflow
- What we do is complex
- How we do it should not be