



Laying Traps

How Infusion Device Interface Design Contributes to Adverse Events

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The USFDA's MAUDE database is filled with reports of adverse events that involve the use of infusion devices, yet offer little insight into why these events happen. Programming complex electronic devices such as infusion pumps provides flexibility that unfortunately abets user confusion, misunderstanding, and disorientation. [1] Widely varying uses for pumps require correspondingly complex ability to program them. Previous research has indicated that the cause for programming difficulties lies in infusion device complexity that is hidden behind the simplified pump user interface. Such programming traps are an unrecognized cause of many of the problems that are reported to the MAUDE database.

Fast-acting medications, including vasoactive drugs and newer anesthetics, require careful attention to dosing and titration. Many require loading prior to the initiation of a maintenance infusion. The transition may require a mode switch. Our research shows that it is necessary but confusing for practitioners to switch modes.

Pump interface design shifts the cognitive work of managing mode transition entirely to the practitioner. The failure to manage this transition has, on occasion, resulted in the over-infusion of vasoactive drugs. A variety of contributing factors can be identified:

- 1) Practitioners expect pump medicine libraries to assist infusion dose programming. In some cases, dosing assistance is available because the drug was not listed in the pump library.
- 2) Practitioners have little training in device operation. What training is provided does not address the broad range of situations that occur during actual work. This forces practitioners to develop their own programming methods, such as turning the device off in order to clear settings.
- 3) Infusion devices vary in the way they are programmed. This results in different device behavior, such as the state of the pump when it is turned on.
- 4) Medication package inserts distinguish between drug loading and infusion parameters but do not provide guidance on how to set-up such sequences.
- 5) Infusion device displays show only current settings and hides information on infusion history and the implications of programming setting consequences.

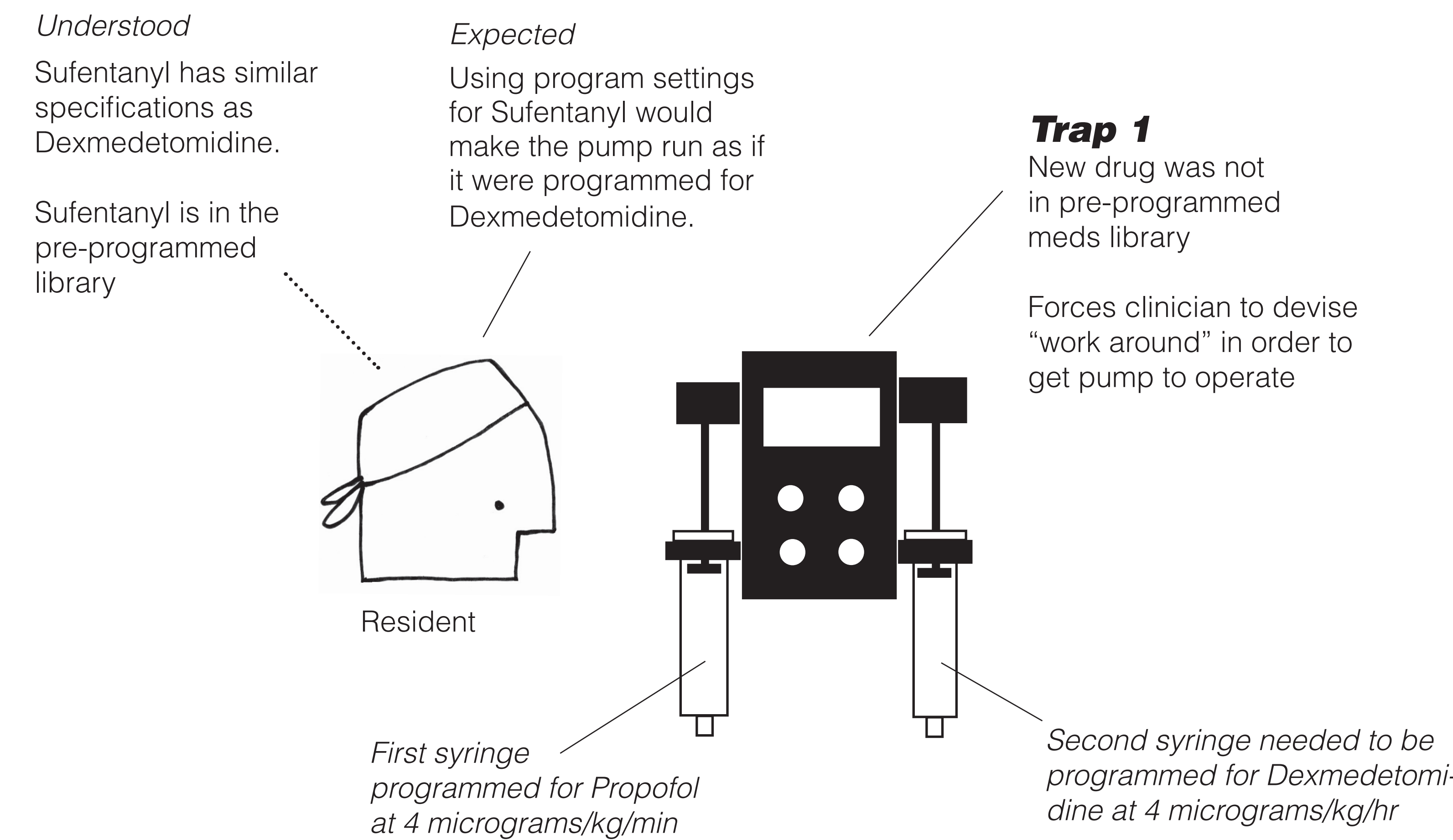
Manufacturer response to MAUDE reports of such events typically assert that the device performed as designed and point to "human error" as the cause. Clusters of adverse events around particular functions of the interface point to problems that are inherent in the pump interface design, not human performance. Mis-operation associated with the infusion of potent medications can produce significant clinical consequences. Such issues deserve the attention of those who seek to develop future device interfaces. [2]

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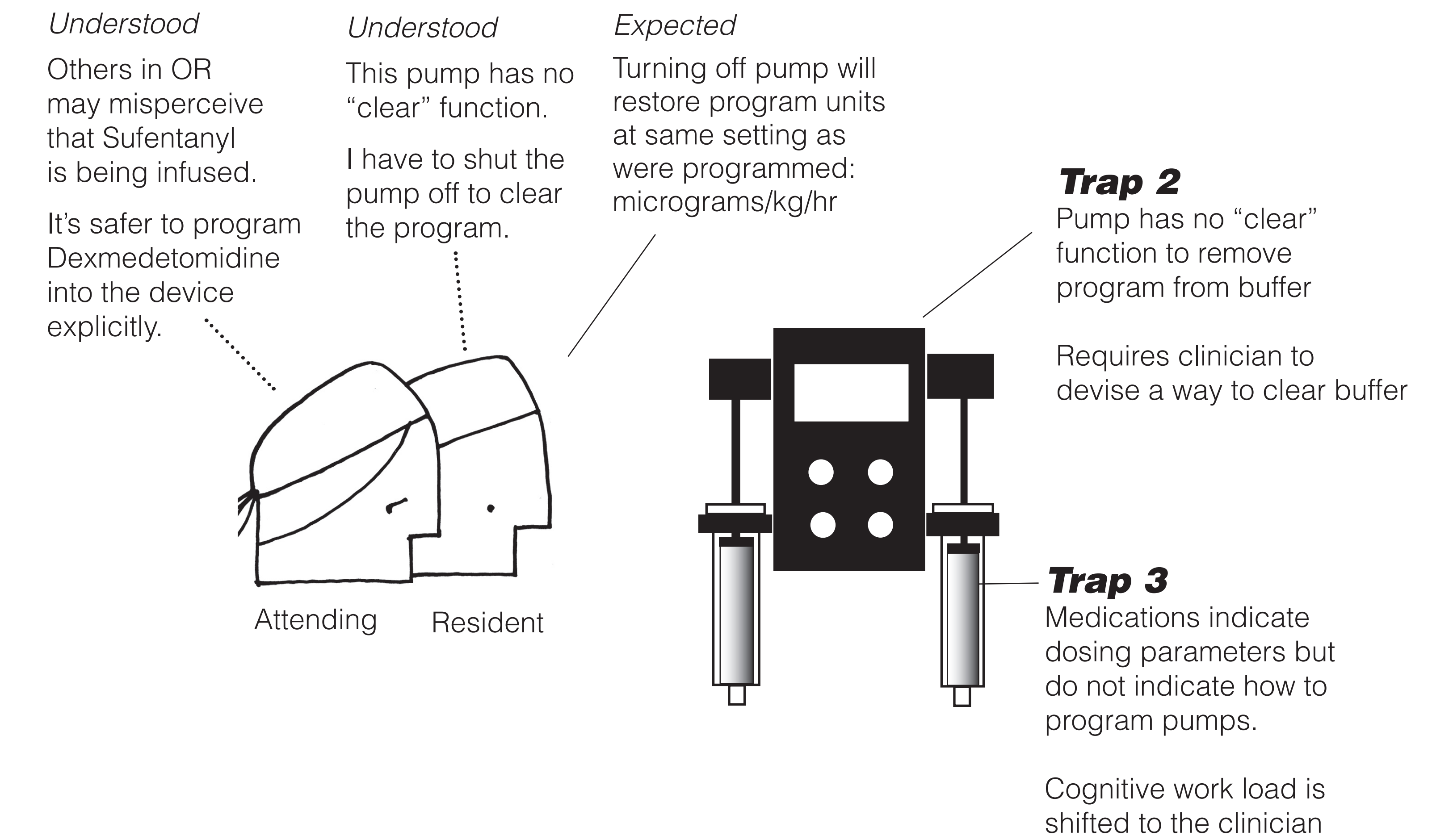
[1] Woods, D. (1993). The Price of Flexibility. *Proceedings of the First International Conference on Intelligent User Interfaces*. 19-25.

[2] Nunnally, M., Nemeth, C., Brunetti, V., and Cook. Lost in MenuSpace: User Interactions with Complex Medical Devices. In Nemeth, C., Cook, R. and Woods, D. (Eds.) Special Issue: Using Field Studies to Understand Technical Work. *IEEE Transactions on Systems Man*

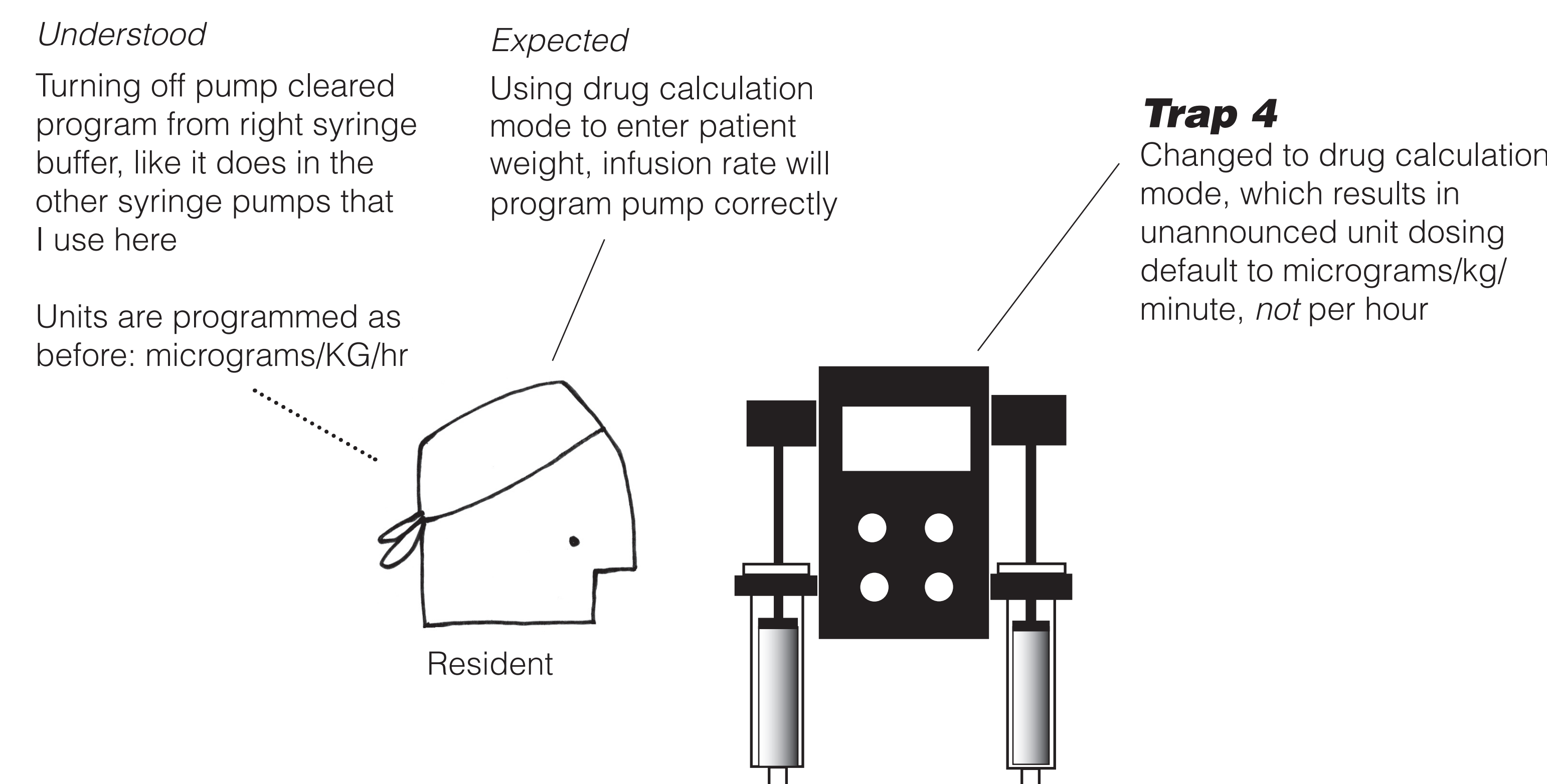
1 Resident needed to program two medications on a two-syringe infusion device



2 In interest of safety, attending prevails on resident to program Dexmedetomidine directly



3 Resident reprogrammed but did not notice subtle default change in unit dosing



4 Attending notes bradycardia, depleted syringe, and reverses overadministration

