Preventing the Occurrence of Wrong-Route Medication Administration Among Patients Receiving Neuraxial Anesthesia Using Neuraxial Route-Specific Medication Administration Equipment: A Systematic Review

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Introduction:

This systematic review examines:

1. The **best available evidence** regarding use of ***neuraxial route-specific medication administration equipment***
   ↳ Specifically, *NRFit; ISO 80369-6*
2. The effectiveness of *reducing or preventing wrong-route medication administration* via implementation of the NRFit system, compared to the currently used standard universal Leur lock type medication administration equipment

Background:

- Neuraxial anesthesia (spinal, epidural, & CSE) is commonly administered with standard Luer lock syringes, needles, & catheters
- Each year, ~**3 million people die** from unsafe healthcare → Medication errors = **half** of these
- Medication-related harm affects **1 in 30** patients.
  >25% *of this harm =* ***severe/life-threatening***
- NRFit (ISO 80369-6) connectors ↓ **risk** of misconnection & unintended wrong-route medication administration

Significance:

Implementation of a *neuraxial route-specific* connection system will make tubing misconnections and wrong-route medication administration *physically impossible*, as the connector size and threads are mechanically incompatible with conventional Luer lock systems, **resulting in:**

Decreased medication errors, and
Increased patient safety

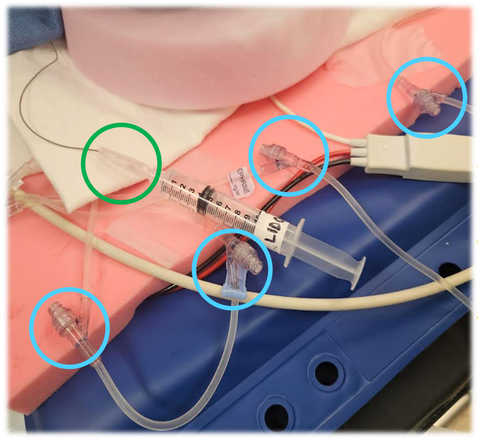
Results & Recommendations:

- NRFit (ISO 80369-6) connection system is an **effective clinical intervention** ***to prevent*** *neuraxial wrong-route* ***medication errors***.
- Currently available evidence strongly supports the adoption of NRFit as a patient-safety measure and harm-reduction strategy.

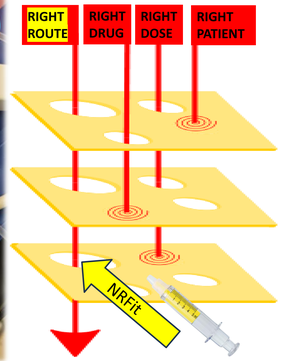
Clinical Scenario:

EMERGENT CRASH Cesarean-Section

Patient is unstable, has working epidural & multiple IV access
Blood products & medications are *rapidly* being administered via different routes to maintain hemodynamic stability & adequate anesthesia.



Opportunity for **ERROR!**



A medication intended for the epidural route could accidentally be administered via the intravenous route…or vice versa!
*Consider** – bupivacaine bolus administered intravenously
*Consider** – blood products administered epidurally
*Consider** – propofol infusion via epidural route (Burbridge & Jaffe, 2021)

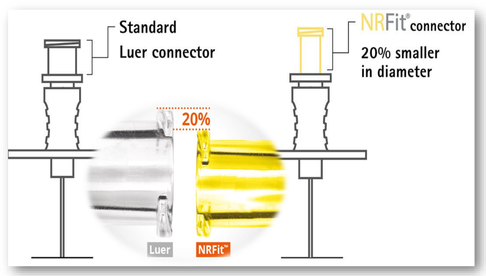
Solution to this problem → NRFit (ISO 80369-6)

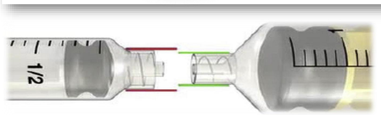
The physical differences between traditional Luer lock devices & *non*-Luer lock neuraxial *route-specific* devices (NRFit; ISO 80369-6) render the equipment **mechanically incompatible**

20% Smaller needle hub

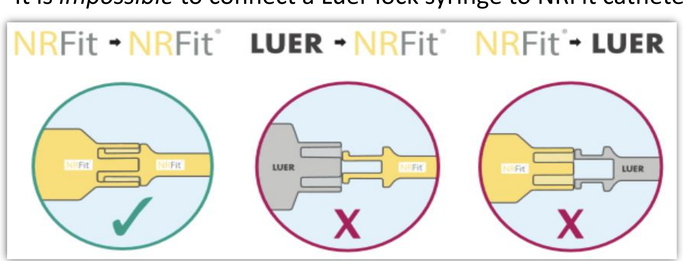
Unique threads

Color Coded: Yellow





- NRFit Syringe will **ONLY** connect to an NRFit catheter hub
- It is *impossible* to connect an NRFit syringe to Luer lock hubs
- It is *impossible* to connect a Luer lock syringe to NRFit catheter



Research Methodology:

Population	Patients receiving neuraxial anesthesia
Intervention	Neuraxial *route-specific* medication administration equipment (i.e., non-Luer lock connectors, specifically NRFit ISO 80369-6)
Comparison	Conventional standard of care; Luer lock devices
Outcome	Prevention or reduction of wrong-route medication errors

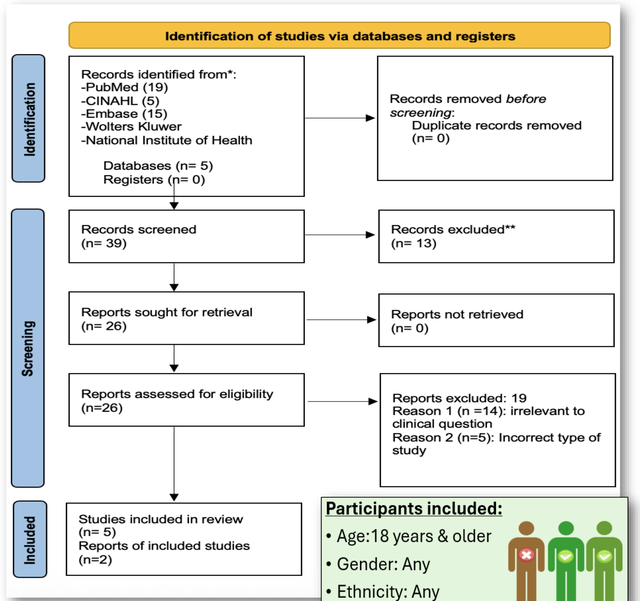
Control
Standard universal Luer lock systems

VS

Intervention
Neuraxial-route-specific non-Luer lock systems (ISO 80369-6; NRFit)

Outcome Measure
Wrong-route medication administration rate

Either
Intravenous intention→ neuraxial administration
Or,
Neuraxial intention → intravenous administration



7 Total Studies Included
- two systematic reviews
- one cross-sectional study
- one case report
- one simulation
- two expert opinions

Participants included:
- Age:18 years & older
- Gender: Any
- Ethnicity: Any

Interventions included:
- Patients must be receiving neuraxial anesthesia (Intrathecal and/or epidural)
- Must utilize the ISO-80369-6 NRFit device or other non-Luer lock technology

Exclusion criteria:
- Patients < 18 years of age
- Patients *not* receiving neuraxial anesthesia

Limitations:

- Quantitative meta-analysis was not feasible
- Qualitative narrative synthesis performed; can be subject to bias
- NRFit is an emerging technology - limited available high-quality evidence exists
- Conclusions should be interpreted with caution

Themes of Review:

> *Mechanical Incompatibility as a Preventive Mechanism*

- Fatal & life-threatening outcomes can result from *misconnections with universal* Luer lock *systems* (Abramyan et al., 2015; Burbridge & Jaffee, 2021; Viscusi et al.,2020)
- **All 7** studies emphasized the mechanical incompatibility of NRFit is the **critical safeguard** against wrong-route drug administrations.
- **NRFit connectors prevented 100% attempted misconnections** in simulation (Cook, et al. 2019)

> *Improved Patient Safety*

- NRFit can play a role in *reducing sentinel events & adverse drug outcomes* (Sancho, 2023; Nair & Diwan, 2021)
- Zero wrong-route events occurred after NRFit implementation over two-year period within Spanish Hospital (Sancho, 2023)

> *Global Ease of Integration into Practice*

- International implementation of NRFit *supports its feasibility* on a global scale & in the U.S.
- Japan adopted NRFit across *over 8,000 hospitals & 100,000* outpatient clinics, with **no reported medication errors** (Omi, Ohmura, & Miyasaka 2024)
- Successful and streamlined integration of NRFit into hospital workflows in Spain (Sancho, 2023)
- NRFit is *highly rated* for its ease of use and reliability (Cook, 2019)

> *Global Patient Safety Initiatives*

- NRFit aligns with global safety standards & regulatory initiatives
- Supported by the Internation Organization for Standardization (ISO), Food and Drug Administration (FDA), and The Joint Commission (Nair & Diwan, 2021)

References & Contact Info