To instantiate and display the given safety case pattern for the Generic Patient-Controlled Analgesia (GPCA) system in a hierarchical tree format, we will fill in the placeholders using the domain information provided. The GPCA system handles the hazards of overinfusion and underinfusion, and we'll address those hazards specifically. The safety requirements and their properties will also be incorporated into the instantiation.

### Hierarchical Tree of Safety Case

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- Goal (G1, Operational safety is verified in GPCA system)

- Strategy (S1, Argument over the satisfaction of all specs over GPCA system)

- Context (C1, All specs are given by {FDA standard, Expertise opinion, Previous knowledge})

- Goal (G2, All operational hazards are mitigated)

- Strategy (S3, Argument over operational hazards)

- Context (C2, Operational hazards are given by {overinfusion, underinfusion})

- Goal (G3, Overinfusion is mitigated)

- Strategy (S4, Argument over the applied scenarios of overinfusion)

- Context (C3, All related scenarios are given by overinfusion)

- Goal (G4, Overinfusion is mitigated under specific scenarios)

- Strategy (S5, Argument over all specs related to specific scenarios)

- Context (C4, All related specs are given by specific scenario specs)

- Goal (G5, Specific spec is appropriate for specific scenario)

- Strategy (S6, Argument the appropriateness of specific spec over properties)

- Context (C5, Properties are given by specific spec properties)

- Goal (G6, Specific property is appropriate for specific spec)

- Strategy (S7, Argument over the source of the property definition)

- Context (C6, Source is given by property source)

- Goal (G7, FDA standard is appropriate and trustworthy)

- Solution (Sn1, FDA standard validation)

- Goal (G8, Property definition is sufficient)

- Solution (Sn2, Definition adequacy documentation)

- Goal (G3, Underinfusion is mitigated) \*(Similarly develops further)\*

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### Explanation:

1. \*\*Top Level Goals and Strategies\*\*: G1 is supported by S1 (strategy) which details how the operational safety is verified based on satisfaction of all specifications. The context C1 provides information on where specifications are drawn from. G2 focuses on mitigating all operational hazards, supported by S3 which discusses the argument structure over these hazards.

2. \*\*Handling Specific Hazards\*\*: Within the strategy S3, two instances of G3 are generated for each of the hazards (overinfusion and underinfusion). Strategy S4 and subsequent goals and strategies breakdown how each hazard is specifically mitigated, with each having its undertree of goals, strategies, contexts, and solutions.

3. \*\*Goal Refinement\*\*: Starting from a general hazard mitigation goal, the case is refined into specific scenarios and specifications. Each goal at a deeper level addresses more specific aspects of the system, leading up to solutions validating the sources and definitions.

4. \*\*Multiplicity and Placeholders\*\*: The GPCA system's multiple operational scenarios and specifications are managed using multiplicity decorators, indicating several different scenarios or properties might need to be handled under each context and strategy based on specific hazards.

This structure provides a clear hierarchical breakdown of how each aspect of the safety of the GPCA system is assured, from general operation down to specific scenarios and properties associated with particular hazards. Each step is supported by evidence or rationale, giving robustness to the safety argument.