Figures:

Fig A

```
export default function FigAConflictArbitrationLadder() {
  return (
    <div className="p-6 flex flex-col items-center text-center">
      <h2 className="text-xl font-bold mb-4">FIG. A — Closed-Loop Conflict Arbitration
Ladder</h2>
      <div className="relative w-full max-w-2xl border-l-4 border-gray-400 pl-8">
        {/* Ladder steps */}
        <div className="mb-6">
          <div className="absolute -left-2 w-4 h-4 bg-red-500 rounded-full"></div>
          <h3 className="font-semibold">Step 1 — Risk Evaluation</h3>
          <p className="text-sm text-gray-600">
            Each loop computes <em>Risk(L)</em> = severity × τ[time_to_harm]/ω[reversibility],
then scaled by ICD-10 weight Θ.
          </p>
        </div>

        <div className="mb-6">
          <div className="absolute -left-2 mt-1 w-4 h-4 bg-yellow-500 rounded-full"></div>
          <h3 className="font-semibold">Step 2 — Apply Safety Edges</h3>
          <p className="text-sm text-gray-600">
            Gating (<code>requires_ok</code>) and mutual-exclusion edges remove ineligible
loops from the active set.
          </p>
        </div>

        <div className="mb-6">
          <div className="absolute -left-2 mt-1 w-4 h-4 bg-blue-500 rounded-full"></div>
          <h3 className="font-semibold">Step 3 — Priority Ladder</h3>
          <p className="text-sm text-gray-600">
            Remaining loops are ordered by numerical Risk, then <code>priority_over</code> graph
rank, forming the arbitration ladder.
          </p>
        </div>

        <div className="mb-6">
          <div className="absolute -left-2 mt-1 w-4 h-4 bg-green-500 rounded-full"></div>
          <h3 className="font-semibold">Step 4 — Select Winning Loop</h3>
          <p className="text-sm text-gray-600">
```

The highest-ranked eligible loop for each <code>conflict_group</code> executes; synergy pairs may co-schedule within Δt.

<h3 className="font-semibold">Step 5 — Log & Verify</h3>

Decision recorded with rationale → tamper-evident audit ledger; new cycle begins.

The ladder illustrates top-down arbitration: only loops clearing all constraints and achieving the highest ICD-weighted risk ascend to execution.

);
}

FIG. B — Risk Queue Sorting with ICD-10 Weight Overlay has been drawn.

It visually compares the base risk ranking against the patient-personalized queue, showing how an ICD-10 code (e.g., *E87.5 Hyperkalaemia*) elevates the K^+ Guardrail loop to top priority after weighting.

```
export default function FigBRiskQueueOverlay() {
  return (
    <div className="p-6 flex flex-col items-center text-center">
      <h2 className="text-xl font-bold mb-4">FIG. B — Risk Queue Sorting with ICD-10 Weight Overlay</h2>
      <div className="grid grid-cols-2 gap-8">
        {/* Left: Base Risk Queue */}
        <div className="border rounded-lg shadow-md p-4 bg-white">
          <h3 className="font-semibold mb-2">Base Risk Queue</h3>
          <ul className="text-left text-sm space-y-2">
```

```
          <li className="flex justify-between"><span>Loop A – Anti-Xa
Control</span><span>Risk = 0.72</span></li>
          <li className="flex justify-between"><span>Loop B – Na⁺
Correction</span><span>Risk = 0.65</span></li>
          <li className="flex justify-between"><span>Loop C – K⁺ Guardrail</span><span>Risk
= 0.58</span></li>
          <li className="flex justify-between"><span>Loop D – Sedation
RASS</span><span>Risk = 0.43</span></li>
        </ul>
      </div>

      {/* Right: ICD-10 Weighted Risk Queue */}
      <div className="border rounded-lg shadow-md p-4 bg-blue-50">
        <h3 className="font-semibold mb-2">ICD-10 Weighted Queue</h3>
        <ul className="text-left text-sm space-y-2">
          <li className="flex justify-between font-bold text-blue-700"><span>Loop C – K⁺
Guardrail (ICD E87.5 Hyperkalaemia)</span><span>Risk = 0.91</span></li>
          <li className="flex justify-between"><span>Loop A – Anti-Xa
Control</span><span>Risk = 0.72</span></li>
          <li className="flex justify-between"><span>Loop B – Na⁺
Correction</span><span>Risk = 0.65</span></li>
          <li className="flex justify-between"><span>Loop D – Sedation
RASS</span><span>Risk = 0.43</span></li>
        </ul>
      </div>
    </div>

    <p className="mt-4 text-sm text-gray-600 max-w-xl">
      The diagram compares queue ordering before (left) and after (right) applying ICD-10
weight overlays.  Here, a diagnosis of hyperkalaemia (E87.5) increases the priority of the K⁺
Guardrail loop, moving it to the top of the execution queue.
    </p>
  </div>
 );
}
```

FIG. C — Conflict-Group Actuator Arbitration Map has been drawn.

It displays three actuator groups (e.g., IV Pump 1, Ventilator, Infusion Pump 2) with their competing loops. The active loop in each group (highlighted in green) represents the winning

command selected by the arbitration engine for that cycle, while others show deferred, gated, or blocked states according to their conflict-graph rules.

```
export default function FigCConflictGroupMap() {
  return (
    <div className="p-6 flex flex-col items-center text-center">
      <h2 className="text-xl font-bold mb-4">FIG. C — Conflict-Group Actuator Arbitration
Map</h2>
      <div className="grid grid-cols-3 gap-6">
        {/* Column 1: Conflict Group A */}
        <div className="border rounded-lg p-4 shadow-md bg-white">
          <h3 className="font-semibold mb-2">Conflict Group A<br/><small>(IV Pump
1)</small></h3>
          <ul className="text-sm text-left space-y-2">
            <li>Loop A1 – Anti-Xa Control — <span className="font-semibold
text-green-600">ACTIVE</span></li>
            <li>Loop A2 – Heparin Protamine — <span
className="text-gray-500">Deferred</span></li>
            <li>Loop A3 – Anti-Xa Override — <span
className="text-gray-500">Blocked</span></li>
          </ul>
        </div>

        {/* Column 2: Conflict Group B */}
        <div className="border rounded-lg p-4 shadow-md bg-blue-50">
          <h3 className="font-semibold mb-2">Conflict Group
B<br/><small>(Ventilator)</small></h3>
          <ul className="text-sm text-left space-y-2">
            <li>Loop B1 – FiO₂ Adjustment — <span className="font-semibold
text-green-600">ACTIVE</span></li>
            <li>Loop B2 – PEEP Titration — <span className="text-gray-500">Gated
(requires_ok)</span></li>
            <li>Loop B3 – SBT Trial — <span className="text-gray-500">Pending</span></li>
          </ul>
        </div>

        {/* Column 3: Conflict Group C */}
        <div className="border rounded-lg p-4 shadow-md bg-green-50">
          <h3 className="font-semibold mb-2">Conflict Group C<br/><small>(Infusion Pump
2)</small></h3>
          <ul className="text-sm text-left space-y-2">
```

```
          <li>Loop C1 – Na⁺ Correction — <span className="font-semibold
text-green-600">ACTIVE</span></li>
          <li>Loop C2 – K⁺ Guardrail — <span className="text-gray-500">Deferred
(mutual_exclusive)</span></li>
          <li>Loop C3 – Mg²⁺ Balance — <span className="text-gray-500">OK
(standby)</span></li>
        </ul>
       </div>
     </div>

     <p className="mt-4 text-sm text-gray-600 max-w-2xl">
       Each column represents a distinct actuator (conflict_group).  The top entry in each
set—highlighted in green—is the winning loop selected by the arbitration engine for that cycle.
Other loops are gated, deferred, or blocked per their graph relationships
(<code>priority_over</code>, <code>requires_ok</code>, <code>mutually_exclusive</code>).
     </p>
   </div>
  );
}
```

FIG. 2.4E

INTEGRATED OVERLAY CONTROL PIPELINE

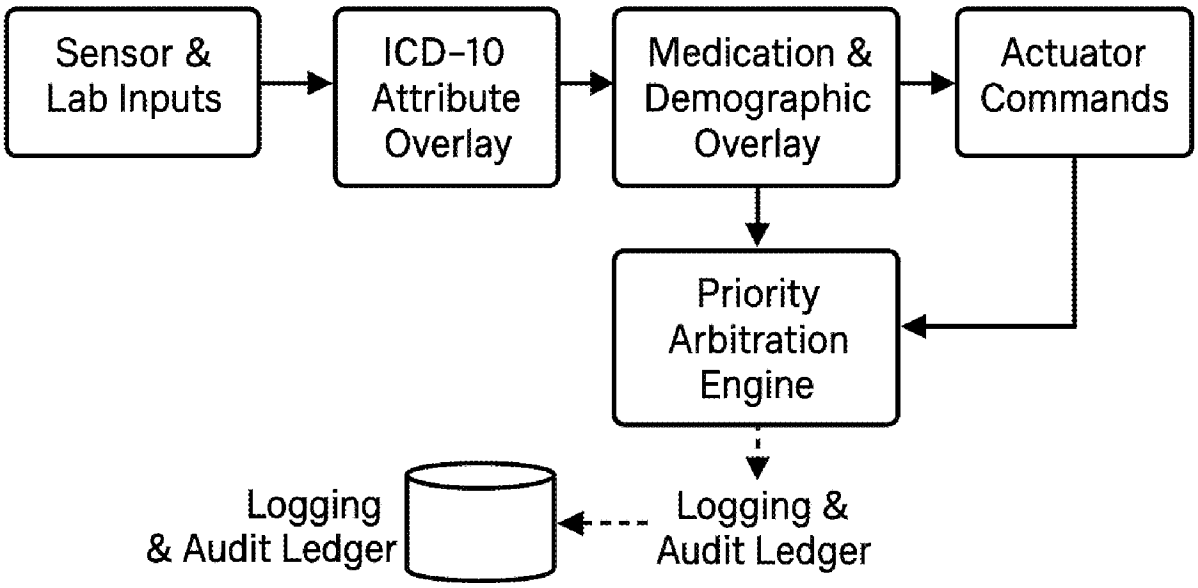
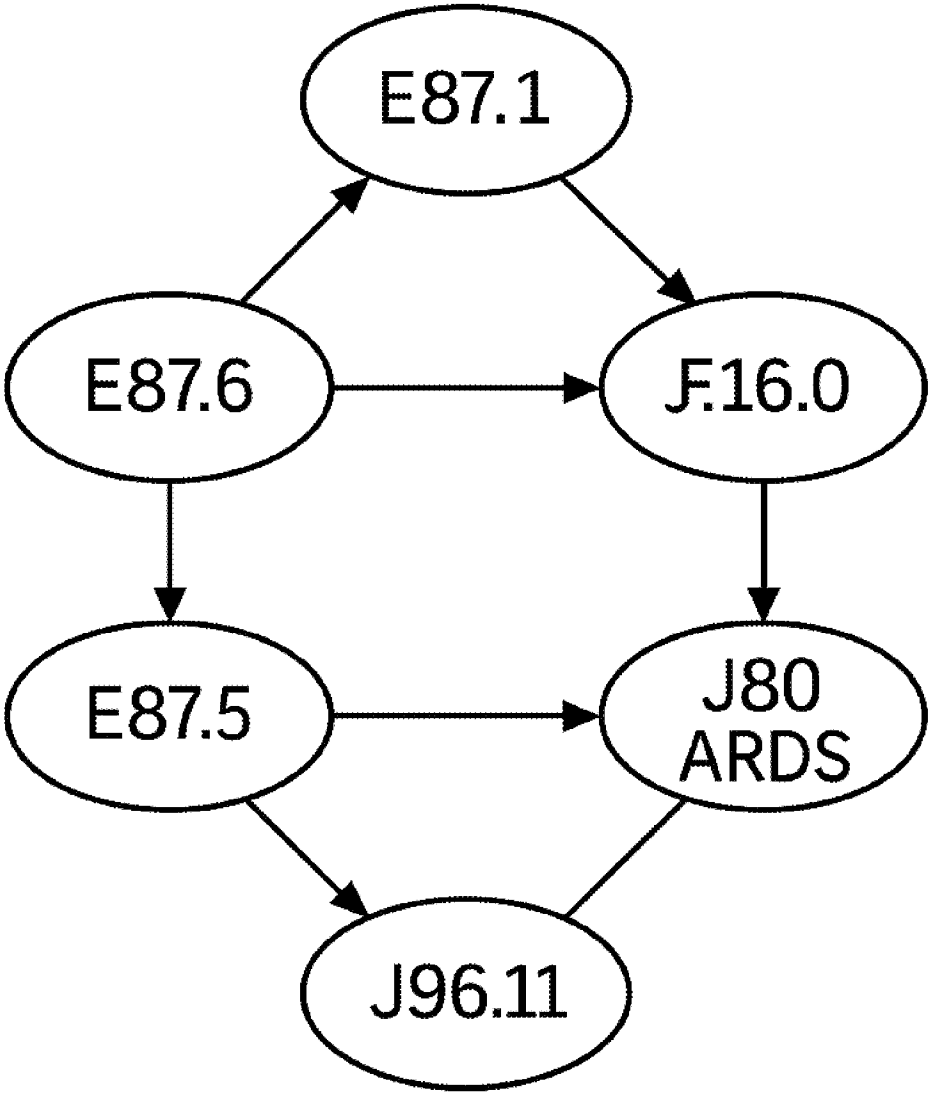


Figure 2.4D:



Representative conflict-resolution graph

FIG. 2.4C – DIAGNOSIS-SPECIFIC OVERLAY EXAMPLES

ICD-10 Code	Trigger	Overlay Attributes
E87.5 Hypokalemia	Serum K^+ <3.5 mmol/L	Risk weight +30% Gating: Insulin requires $K^+ \geq 3,5$
E87.1 Hyponatremia	Serum Na^+ rise >8 mmol/l/24h	Risk weight +80% Guard rail: Sa ≤ 8 mrol/d
R65.21 Septic shock	Passive-leg-raise (PLR) positive	Risk weight +90% Gating: Synergy: PLR + fluids + antibiotics

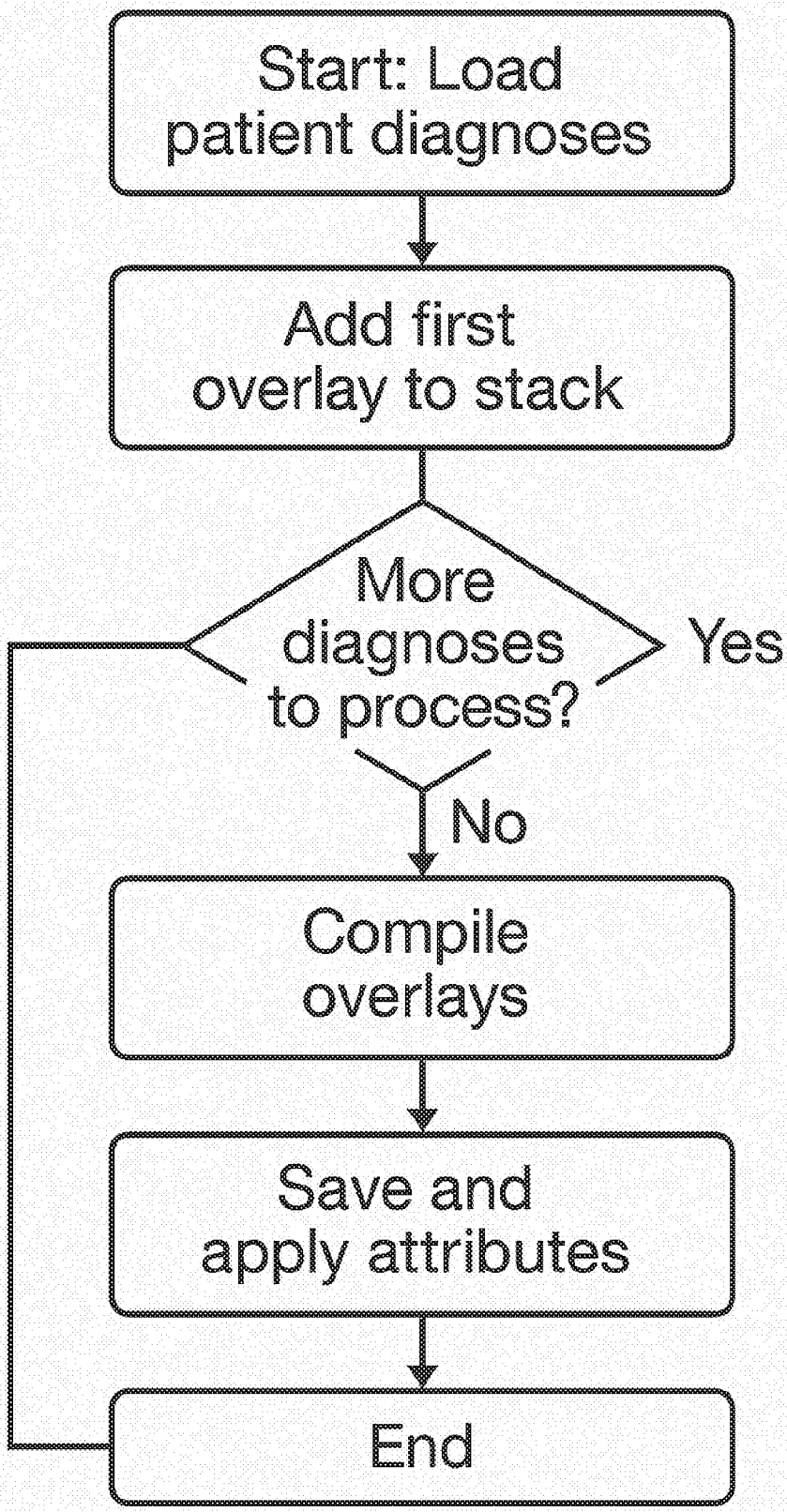
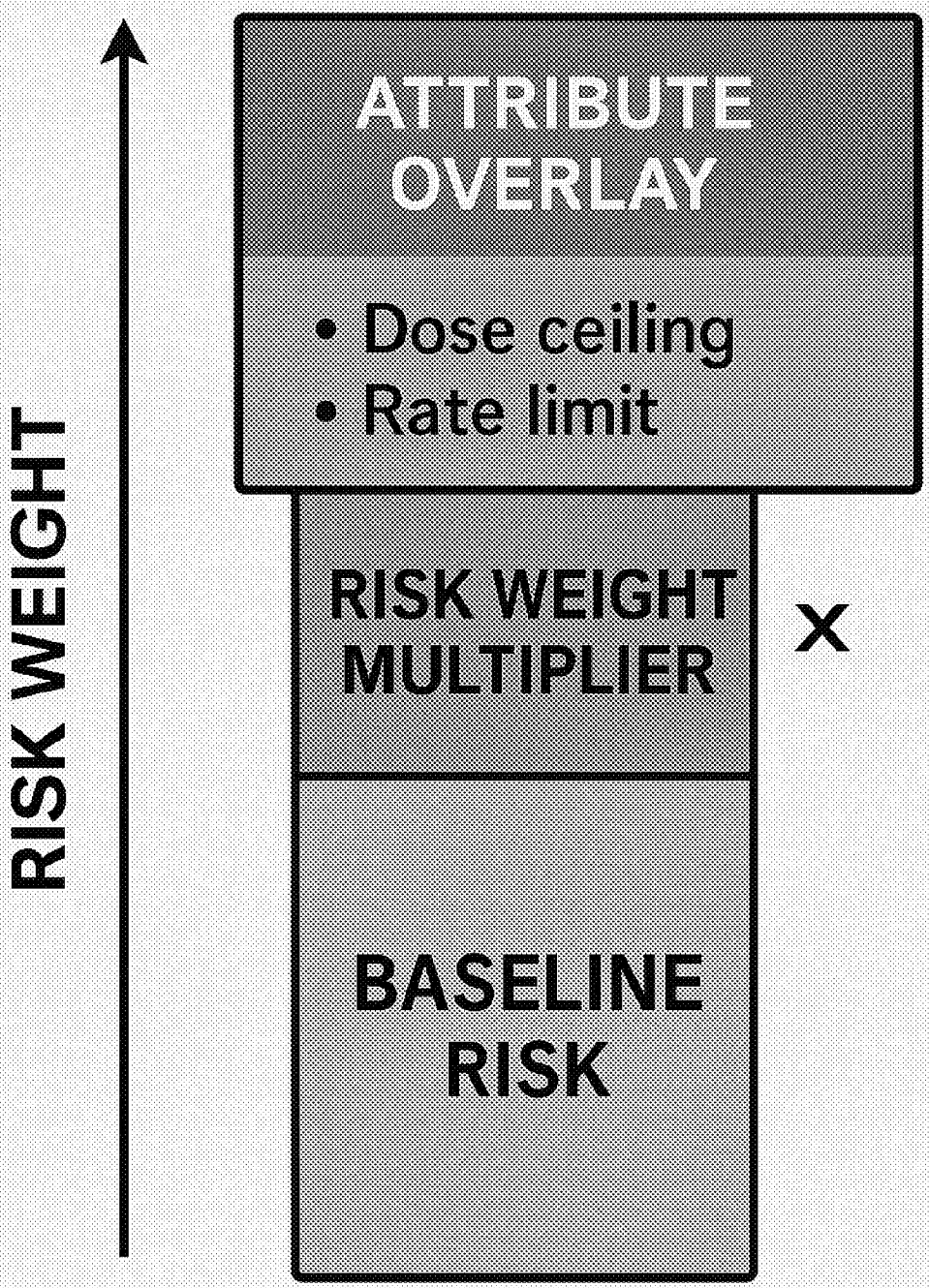


FIG. 2.4B Overlay compilation algorithm

FIG. 2.4A



Risk Weight vs Attribute Overlay