Virtualized Hospital Architecture Maturity Roadmap

Virtual Hospitals are cloud-based, flexibly-resourced, stand-alone health information management systems that work in variable network environments to create capability and capacity at the point of need.

LEGEND:
- 0 — Manual: Performed Locally
- 1 — Manual + Remote Support
- 2 — Manual + AI Decision Support
- 3 — AI: Human IN the Loop
- 4 — AI: Human ON the Loop
- 5 — AI: No Human/Closed Loop

Initial Clinical Capabilities	Near (1-5 yrs)	Mid (5-15)	Far (>15 yrs)
Area 1: Digital Health at Home			
Health Sensors	2	3	4
Mobile Device Decision Support	2	3	4
Interventions and Procedures	0	2	4
Heads-up Augmented Reality	2	4	4
Area 2: Virtual Clinic			
Mobile/Home Physical Exams (PE)	1	3	4
PE with Movement/Manipulation	0	3	4
Home Meds/Vaccination Admin	0	3	4
Point of Care Testing	0	3	4
Tele-Mentoring/Coaching	1	3	4
Mobile Imaging & Diagnostics	1	2	4
Area 3: Virtual Hospital Ward			
Home Acute Care Monitoring	2	4	4
Virtualized Care Clinician Workflows	0	3	4
IV Pump Management	3	5	4
Mobile Oxygen Delivery	0	3	4
Patient Positioning Equipment	0	3	4
Area 4: Virtual Intensive Care Unit			
Continuous Patient Monitoring	2	4	4
Ventilator Support (Mech Vent)	4	5	4
Renal Support (CRRT)	4	5	4
Cardio Pulmonary Support (ECMO)	4	5	4
Clinical Nutrition Support	0	2	4
Invasive Procedures (Airway, A-line)	0	3	4
Blood Purification/Pathogen Reduce	2	4	4
Sedation and Anesthesia	2	5	4
Shock Resuscitation	0	3	4
Area 5: Virtual Operating Rooms			
Surgery	0	4	4
Blood Recovery	0	2	4
Nanotech/Molecular Casualty Care	✕	2	4
Neurotech Casualty Care	✕	✕	4

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A. Synchronization & Workflow

Technology Stack	Near (1-5 yrs)	Mid (5-15)	Far (>15 yrs)
Autonomous Data Entry	✗	✓	✓
Secure, Standards-Based IoT Framework	✓	✓	✓
Virtual Workflows, Training, & Policy Dev	✓	✓	✓
Simulation/Scenario Based Staff Training	✓	✓	✓
Data Visualization - Volume/Acuity	✓	✓	✓
Data Visualization - Resource Allocation	✗	✓	✓
Data Visualization - Predictive	✗	✓	✓
Home Health Virtualization Online	◐	✓	✓
Clinic Virtualization Online	✓	✓	✓
Hospital Ward Virtualization Online	✓	✓	✓
Hospital ICU Virtualization Online	✓	✓	✓
Operating Room Virtualization Online	✗	◐	✓

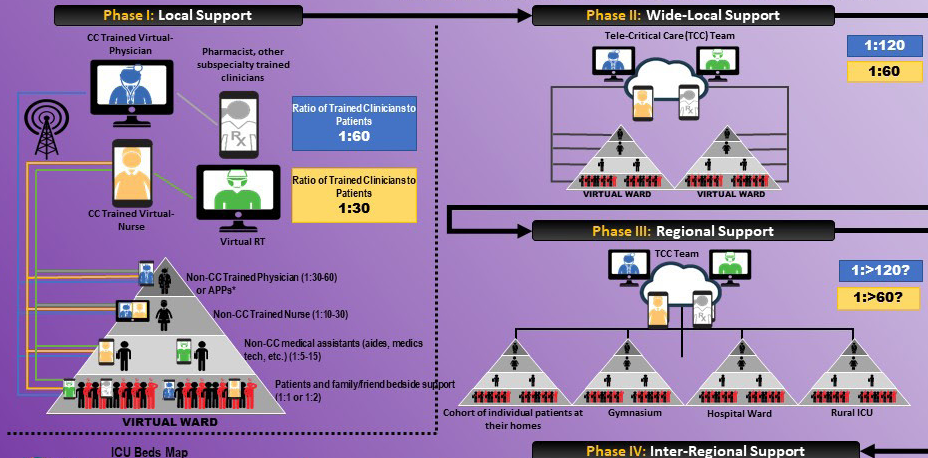## B. Medical "Stuff" – Medication, Supply, Blood, Delivery & Fabrication
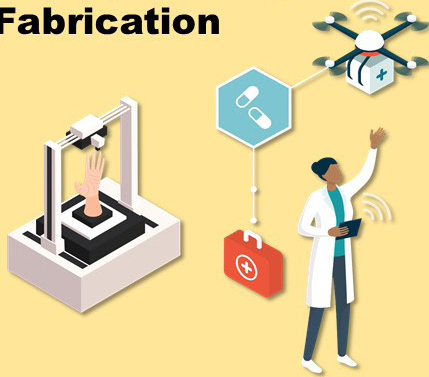
Technology Stack	Near (1-5 yrs)	Mid (5-15)	Far (>15 yrs)
Patient Care-to-Patient Services	✓	✓	✓
3D Printing - Simple Devices	✓	✓	✓
3D Printing - Complicated Devices	✗	✓	✓
3D Printing – Bio-printing	✗	◐	✓
4D Printing - Simple Circuitry	✓	✓	✓
4D Printing - Complicated Circuitry	✗	◐	✓
Artificial Fluids	✗	✓	✓
Pharmacological Printing	✗	✓	✓
Drone Delivery <10 lbs.	✓	✓	✓
Drone Delivery >600 lbs. (CASEVAC)	✓	✓	✓
Drone Delivery >600 lbs. (MEDEVAC)	✗	✓	✓

NETCCN

NATIONAL EMERGENCY TELE-CRITICAL CARE NETWORK

Tiered Staffing with Remote TCC Support

Phase I: Local Support
- CC Trained Virtual-Physician
- Pharmacist, other subspecialty trained clinicians
- CC Trained Virtual-Nurse
- Virtual RT
- Ratio of Trained Clinicians to Patients 1:60
- Ratio of Trained Clinicians to Patients 1:30
- Non-CC Trained Physician (1:30-60) or APPs*
- Non-CC Trained Nurse (1:10-30)
- Non-CC medical assistants (aides, medics tech, etc.) (1:5-15)
- Patients and family/friend bedside support (1:1 or 1:2)
- VIRTUAL WARD

Phase II: Wide-Local Support
- Tele-Critical Care (TCC) Team
- 1:120
- 1:60
- VIRTUAL WARD / VIRTUAL WARD

Phase III: Regional Support
- TCC Team
- 1:>120?
- 1:>60?
- Cohort of individual patients at their homes / Gymnasium / Hospital Ward / Rural ICU

Phase IV: Inter-Regional Support

Enabling Technologies:
- Cellular network/Mobile Devices
- Elastic Cloud Computing
- Internet of Things
- Big Data and Artificial Intelligence
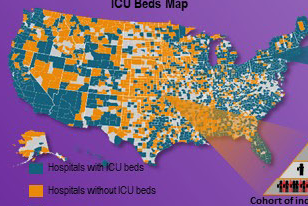- Augmented Reality

Complementary efforts:
- Incorporate additional sensors (wearables)
- Remote control of devices (ventilators/IV Pumps)
- Automated logistics/supply
- Automating devices/systems
- Device interoperability (plug and play)
- EHR Integration
- Robotic procedural support

ICU Beds Map
- Hospitals with ICU beds
- Hospitals without ICU beds
- No Hospitals

Cohort of individual patients at their homes / Gymnasium / Hospital Ward / Rural ICU — VIRTUAL WARDS

Large Containment Areas (e.g. The Superdome)

Rural ICU / Hospital Ward / Gymnasium / Cohort of individual patients at their homes — VIRTUAL WARDS

*APPs (Advanced Practice Providers: PAs, NPs, CRNAs etc.) – some are CC Trained and some are Non-CC Trained.

For more information on the TATRC Virtualized Hospital Architecture Maturity Roadmap, Please Contact:
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