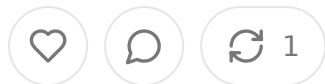


The labor problem healthcare won't solve with recruiting

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Key data points and framing:

- US hospital labor costs = ~60% of total operating expenses, up from ~55% pre-pandemic
- Nursing shortage projected at 450,000 RNs by 2025 per McKinsey; actual shortage worse post-COVID
- Travel nurse spend alone hit ~\$11.6B in 2022 (Kaufman Hall); some systems spend 40% of nursing budget on agency
- Healthcare revenue cycle outsourcing = \$50-80B TAM per Sequoia's own mapping

- Physical/robotic automation in hospitals still under 5% penetration by most estimates
- Hospital systems operate on 1-3% net margins even in good years; labor is the largest lever
- Sequoia's core thesis: for every \$1 spent on software, \$6 goes to services; in healthcare the ratio is probably closer to 1:10 or worse
- The robot market in healthcare logistics/clinical support expected to reach \$12 billion by 2030 (various analyst estimates)
- AI agent software replacing services = the first wave; humanoid and task-specific robots = the second wave; convergence of both = where the real wealth gets built

The Staffing Crisis Nobody Wanted to Talk About

The hospital staffing crisis did not sneak up on anyone. Workforce consultants, hospital CFOs, and healthcare economists were all saying the same things through the 2010s: the nurse pipeline was narrowing, physicians were burning out at alarming rates, and the demographics of the clinical workforce skewed old enough that retirement waves were inevitable. Everyone nodded along at conferences, published white papers, and then went back to optimizing charge capture and EHR implementations. The crisis arrived anyway, on schedule, and COVID poured accelerant on a slow fire and turned it into something unmanageable almost overnight.

What happened between 2020 and 2023 in hospital labor markets was not just a staffing disruption, it was a fundamental repricing of clinical labor. Travel nurses who were earning \$35 an hour pre-pandemic were suddenly commanding \$100, \$120, \$150 per hour on short-term contracts. Kaufman Hall tracked aggregate travel nurse spend reaching \$11.6 billion in 2022 across major health systems, a number that would have seemed implausible in 2019. Some large regional systems were allocated

35 to 40 percent of their total nursing budget to agency and travel contracts just keep units staffed. The economics were ruinous, and the margin compression was immediate. For context, most nonprofit hospital systems operate on net margins between one and three percent in a good year. A 15-point swing in nursing labor is not an inconvenience, it is an existential event.

The systems that survived relatively intact were the ones that had invested in workforce management infrastructure, or that happened to be located in markets with stronger pipeline programs. The ones that struggled most were community hospitals and rural systems with no pricing power over labor markets and no institutional reserves to absorb the shock. A number of them did not survive at all. Rural hospital closures accelerated, and the M&A activity in nonprofit healthcare during 2022 and 2023 was largely driven by distressed assets being absorbed by larger systems that could spread fixed costs across more volume.

All of this matters for the investor and entrepreneur thesis because it created something rare in healthcare: genuine urgency around the cost structure. Hospital executives who had resisted labor substitution for years, partly for patient safety reasons and partly because of union dynamics, suddenly found themselves in boardroom conversations where the alternative to automation was insolvency. That kind of urgency is the conditions under which technology adoption actually accelerates in an industry that otherwise moves at a geological pace. The window opened, and it stayed open because the structural drivers did not go away when the acute crisis eased. The nursing shortage projected by McKinsey at roughly 450,000 RNs by the mid-2020s was not a post-pandemic artifact, it was a pipeline and demographic problem that was going to show up regardless. Post-pandemic stabilization just masked the underlying deficit for a few years while systems burned cash on agency contracts.

What Sequoia Got Right (and What They Left Out)

Sequoia's March 2026 framework on services as the new software is genuinely useful and worth reading seriously. The core observation is clean: for every dollar spent

software, six go to services. Autopilot companies that sell the work rather than the tool capture the services budget from day one rather than hoping to expand from tool contract later. The framing of intelligence versus judgement as a way to identify which service categories are ripe for automation first is also solid. High intelligence ratio, already outsourced, outcome-based purchasing, clear ROI: those are the four conditions that make a category ready for an autopilot to walk in and replace a vendor contract.

Sequoia's opportunity map places healthcare revenue cycle at 50 to 80 billion dollars in outsourced spend, calls it almost pure intelligence work, notes the outsourcing is already mature and outcome-based, and names Anterior as the furthest along. The map is all directionally correct. Medical coding is genuinely the translation of clinical documentation into roughly 70,000 standardized ICD-10 codes. The rules are Byzantine, but they are still rules. A well-trained model with the right clinical context handles this better than offshore coders working under productivity quotas, and scales in a way human coding teams cannot. Authorization management is a similar story. The average prior auth workflow involves querying payer portals, matching clinical criteria against coverage policies, drafting appeal letters when denials come back, and tracking everything through resolution. There is almost no judgement in that workflow, just rules running against rules, which is exactly where AI agents operate best.

What the Sequoia piece does not fully develop, for understandable reasons since it is a generalist framework, is that revenue cycle is really just the anteroom in healthcare. The bigger rooms are clinical operations, supply chain, environmental services, patient transport, and the physical coordination work that makes a hospital function as a physical plant. These categories represent labor spend that dwarfs revenue cycle and they sit on the other side of a wall that software alone cannot cross. Revenue cycle workers sit at computers. They push data. Replacing them with software agents is a distribution and integration problem, hard but tractable. The nurses, the surgical techs, the phlebotomists, the patient transport staff, the people doing medication delivery and environmental services rounds: they move through physical space, the

touch patients, they carry things, they respond to unpredictable real-world conditions. Software cannot help you there. Robots can.

The other thing the framework undersells, not incorrectly but incompletely, is compounding. The autopilot companies that win in healthcare will not win because they automated one revenue cycle function. They will win because every claim they touch, every auth they process, every coding decision they make feeds a model that gets better at the next decision. The data moat in healthcare AI is not metadata or clickstream data, it is actual clinical and financial transaction data flowing through real workflows. The companies that get into the workflow early, even on the narrow intelligence tasks, are the ones that will have the proprietary data stack to eventually handle more judgement-adjacent work. The wedge is always about data accumulation as much as it is about revenue.

Revenue Cycle Is Just the Warm-Up

Being concrete about where the AI agent opportunity in healthcare revenue cycle actually sits is useful because it tends to get oversimplified in both directions. Some people treat it as solved because a few well-funded companies exist. Others dismiss it as too complex given payer variability and clinical documentation quality. The honest answer is that it is neither solved nor impossibly complex. It is a large, fragmented market where the structural conditions for disruption exist but where execution is genuinely hard.

The revenue cycle technology market, inclusive of outsourced services, software, hybrid arrangements, is probably somewhere between 100 and 150 billion dollar aggregate annual spend in the US. That number includes the big outsourcing players like Optum360, Conifer, Ensemble Health, and nThrive, but also the technology vendors selling into the insourced revenue cycle functions at large health systems. The pure outsourced services slice that Sequoia sizes at 50 to 80 billion is the more immediately actionable target for autopilot-style companies, because those companies already price on outcomes rather than seats.

The specific functions where AI agents are making real traction right now are prior authorization, denial management, coding, and patient financial clearance. Prior authorization is a particularly good example because the workflow is well-defined, the downstream financial impact is enormous, and the human workforce doing this work is almost entirely keyboard-based. A single academic medical center might have 60 or 80 full-time employees doing nothing but prior authorization management. At fully loaded labor costs of 70 to 90 thousand dollars per head, that is six to seven million dollars annually in a single department, at a single hospital, for one function. The national aggregate is several billion dollars. Replacing even half of that with agents is a meaningful business.

Denial management is the downstream version of the same problem. When authorizations fail or claims get denied, someone has to identify the root cause, determine whether an appeal is worthwhile, draft the appeal, route it correctly, and track it through resolution. The denial rate across the industry averages somewhere between 5 and 10 percent of submitted claims, with enormous variation by payer and by specialty. At a health system doing two billion in net revenue, a 7 percent denial rate with 40 percent recovery through appeals represents hundreds of millions of dollars in at-risk revenue annually. The people managing that process are not doing complex clinical reasoning. They are running decision trees against payer policies. Agents do that work well, often better than humans on pure accuracy, and without attrition and training costs that plague large revenue cycle departments.

The next wave inside revenue cycle is going to be more interesting than what exists now, because it will start to touch functions that currently require some coordination between revenue cycle and clinical operations. CDI, clinical documentation improvement, is a good example. CDI specialists are typically nurses or experienced coders who read physician documentation and identify gaps or ambiguities that affect coding accuracy and therefore reimbursement. That work sits at the boundary of intelligence and judgement, because it requires reading clinical context, not just applying rules to structured data. Models that are good enough to do CDI work at scale would unlock a much larger revenue impact than pure coding automation, and a few companies are starting to make credible moves in that direction.

The Physical Layer: Why Robots Are the Real Endgame

Sequoia's autopilot framework is mostly a software frame. Sell the work, not the capture the services budget, let model improvements compound your margins. This thesis is correct and there will be multiple large businesses built on it in healthcare. But it stops at the edge of physical space, and that is where the genuinely large healthcare labor story lives.

Hospital labor economics are brutal in ways that software cannot fully address, because a significant portion of hospital labor is irreducibly physical. The Bureau of Labor Statistics data on hospital labor composition is instructive here. Registered nurses represent roughly 25 to 30 percent of hospital FTEs. Allied health professionals, including surgical techs, respiratory therapists, imaging techs, and physical therapists, account for another 15 to 20 percent. Environmental services, patient transport, dietary, and facilities together account for somewhere between 10 and 15 percent of FTEs at most large systems. Physicians and advanced practice providers are another 15 to 20 percent. Administrative and revenue cycle staff, the people software agents can most directly replace, are maybe 20 to 25 percent of the total.

So even a perfect outcome in software-based automation of administrative work can only address 20 to 25 percent of hospital FTE spend. The other 75 to 80 percent involves physical presence, clinical assessment, hands-on care, or some combination of these things. That does not mean it is immune to automation. It means the automation vector is robots, not software. And the transition from software automation to robotic automation in healthcare is not a far-future scenario anymore. Several distinct robotic categories are already in deployment, and the investment activity in the space reflects a genuine conviction that the trajectory is real.

The most mature category is surgical robotics. Intuitive Surgical has been a durable large cap for years, and the robotic-assisted surgery market is now large enough that multiple platforms are in serious clinical use. The argument for robotic surgery from a labor economics standpoint is not primarily about replacing surgeons, though

very long time horizon that conversation will happen. The near-term argument is about extending surgical capacity, reducing fatigue-related variability, and allowing procedures to happen in settings that do not currently have access to subspecialty surgeons. That last point matters enormously for health system strategy, because surgical volume drives hospital margin in ways that few other service lines do.

The more interesting near-term investment category from a pure labor substitution angle is hospital logistics and environmental services. These are high-volume, repetitive, physical tasks that do not require clinical judgment, just reliable navigation, object manipulation, and task sequencing. Autonomous mobile robots for medication delivery, lab specimen transport, linen and supply distribution, and waste management are already deployed in a meaningful number of hospitals. Aethon robots have been around long enough that they are now on their second generation deployment at large academic medical centers. Moxi, developed by Diligent Robotics, handles room stocking and delivery tasks and has accumulated enough real-world hospital hours to generate actual operational data on labor impact. The early results from systems using these platforms are credible: somewhere between 30 and 60 percent reduction in staff time on the specific transport and logistics tasks they handle, which translates to either headcount reduction or redeployment to higher acuity patient care work.

The next frontier, and the place where the investment community is writing the speculative but also potentially most consequential checks, is humanoid robots in clinical settings. This is not yet a deployed product category in any meaningful sense. Boston Dynamics, Figure, 1X, and Apptronik are all building general-purpose humanoid platforms, and several of them have announced partnerships or pilot conversations with healthcare systems. The theoretical value proposition is significant. A humanoid robot that can reliably perform patient transport, ambulation assistance, vital sign collection, medication delivery, and environmental services rounds would address a substantial fraction of total nursing assistant and technician work in a hospital. The current cost of a humanoid platform is still too high for the unit economics to work cleanly, but the trajectory on both cost and capability is steep, analogous to industrial robotics adoption curves, and to early autonomous vehicle

timelines corrected for hindsight, suggest a realistic deployment window of five years for limited clinical tasks at scale.

The clinical judgment layer is where the timeline gets harder to specify. Replacing a nurse doing medication administration is not just a manipulation problem, it is a clinical assessment problem. The nurse administering a medication is also watching the patient's color, noticing respiratory changes, asking questions, and making implicit assessments that are not documented anywhere but that matter enormously for patient safety. That layer requires multimodal sensing, natural language, and time clinical reasoning in a way that current robotic systems are not close to handling reliably. But the sub-tasks that do not require that level of clinical judgment, and there are more of them than most people acknowledge, are accessible to current near-future robotic systems. The bet the smart investors are making is not that robots replace nurses entirely, it is that robots handle the intelligence-ratio tasks within nursing workflows and free clinical staff to concentrate on the judgment-intensive work. That is exactly the same framing Sequoia applies to software services, just translated to physical space.

What This Means for Investors and Founders Right Now

The investment thesis in healthcare labor automation is not one bet, it is a stack. The bottom of the stack is software agents automating revenue cycle and administrative functions, a market that is large, accessible today, and where the distribution mechanisms are relatively clear. The middle of the stack is logistics and environmental services robots, a category where the technology is proven enough to deploy but adoption is still in early innings and the sales cycle into hospital operations is long and relationship-dependent. The top of the stack is humanoid clinical robots, a category where the technology is still developing but where the proposition is enormous enough that patient capital makes sense now even without near-term revenue.

For angel investors and seed-stage funds specifically, the most interesting check-writing zone right now is probably the intersection of AI agents and revenue cycle because the time-to-revenue is shortest and the validation mechanisms are clear. Health systems will tell you in a procurement conversation whether your automation is outperforming their current vendor. Denial management and prior auth are numerically scorable in ways that make the ROI conversation relatively clean compared to most healthcare sales. Companies in this space that are reaching meaningful revenue scale are also the most interesting acquisition targets for the RCM outsourcing players, which creates a near-term exit path that is not dependent on public market conditions.

The more interesting but harder bet for investors who have longer time horizons is the robotic layer. The companies building clinical logistics robots are past the concept stage and into the scaling problem. The cost per robot is still high enough that the ROI math only works well at large systems, but that is the same early adoption problem that every capital equipment category goes through. The systems that are adopted now are doing so partly because the economics are marginal but improving, and because they are positioning for a future where the labor shortage makes any alternative look attractive. The founders building in this space need to understand hospital operations deeply, not just robotics, and the best teams are typically coming out of clinical engineering backgrounds or long careers in health system operations rather than pure robotics labs.

The humanoid clinical robot bet is for the patient and technically sophisticated. There are real companies with real engineering progress, and several of the general purpose humanoid platforms will eventually be deployed in clinical settings whether they are purpose-built for healthcare or not. The question is timing and which capabilities get unlocked first. Founders building specifically for healthcare deployment of humanoid platforms need a clear view on the regulatory path, which will be significant, and a realistic model for liability in clinical settings. Those are not insurmountable problems but they are real ones that add years to deployment timelines.

The common thread across all three layers is data. The AI agent companies that win the revenue cycle will win partly on their model quality and partly on the proprietary transaction data they accumulate. The robot companies that win in hospital logistics will win partly on hardware reliability and partly on the operational data they collect about hospital movement patterns, task completion rates, and failure modes. The future humanoid clinical platforms will win partly on general capability and partly on the clinical context data that makes them trustworthy in patient-facing settings. Healthcare is a domain where proprietary data is extraordinarily hard to acquire at scale, which means the companies that get into workflows early have structural advantages that compound. The wedge is always about more than the first dollar of revenue.

The Uncomfortable Math

It is worth being direct about something that tends to get softened in polite healthcare technology conversations. The ultimate value proposition of AI agent clinical robots in hospitals is replacing human labor with software and hardware. It is not a side effect of the technology thesis, it is the thesis. The financial case for health systems is predicated on labor cost reduction. The investment case for the companies building these tools is predicated on labor being the dominant cost category in their target customer's operating budget. Dressing this up as workflow augmentation or care quality enhancement is not wrong, those things are also true, but the unit economics work because labor gets replaced or reduced, not just augmented.

For a health system running a billion dollars in annual operating expense, with roughly 600 million of that being labor, a 15 percent reduction in total labor through a combination of agent-based administrative automation and robotic logistics would represent 90 million dollars in annual savings. At even a conservative three to four times multiple on savings, that is a business case that supports substantial capital investment. The hospital gets margin improvement, the technology vendor gets a contract, and the investors backing the technology vendor get a return. The world

who lose jobs get, in the best case, redeployment to higher-acuity work and, in the good case, displacement.

The healthcare investor and entrepreneur community tends not to dwell on that part, and there are legitimate reasons for that beyond simple discomfort. Health systems genuinely are operating under financial conditions that threaten community access to care. Rural hospital closures hurt patients, not just shareholders. If robotics and AI can stabilize the cost structure enough to keep hospitals operating in underserved markets, there is a real public health argument alongside the financial one. That does not make the displacement question disappear, but it does mean tradeoffs are genuinely complicated in healthcare in ways they might not be in, say, insurance brokerage.

What is not complicated is the direction of travel. Every major health system in this country has a workforce transformation initiative running right now. The language varies, some call it care team redesign, others call it operational efficiency, a few are honest enough to call it labor optimization, but the destination is the same. More work done by technology, fewer humans required per unit of care delivered. The companies that help health systems get there faster and with better outcomes will build large businesses. The investors who identify those companies early will get strong returns. The timing on the robotic layer is the main uncertainty, not the direction.

The Sequoia thesis that services are the new software is right, and healthcare is the largest single services market in the domestic economy. The software automation wave is already breaking. The robotic wave is the one that will define the next decade of health system economics. Founders and investors who are thinking about this as a single market rather than two sequential waves are the ones who will position themselves correctly for both.

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