CAPSTONE 4

BillShield

The Hospital Bill That Nobody Can Read, Nobody Can Challenge, and Everybody Pays

100xEngineers · Applied AI Capstone Series

The Situation

Ankit is 34 years old, a software engineer in Pune. His father, 62, was admitted to a private hospital for chest pain. Three days in the ICU. Diagnosis: acute gastritis, not cardiac. Discharge bill: ₹4,87,000.

Ankit has health insurance with a ₹5 lakh cover. The hospital filed a cashless claim. The insurer approved ₹2,94,000 and rejected the rest, citing "non-payable items" and "room rent capping." The hospital is now demanding ₹1,93,000 from Ankit before discharge. They will not release his father until he pays.

Ankit does not know which charges are legitimate and which are inflated. He does not know that the hospital charged ₹19,000 for a CT scan that CGHS rates at ₹2,500. He does not know that eight doctors were billed when only two examined his father. He does not know that medicines were billed at 300% of MRP. He does not know that the "non-payable items" the insurer rejected are actually covered under IRDAI's 2025 guidelines. He does not know that the insurer is legally required to settle within 15 days or auto-approve.

The hospital knows all of this. The insurer knows all of this. Ankit, standing outside the ICU with his father's clothes in a plastic bag, knows none of it.

This is not a hypothetical. India's health insurance market has crossed ₹1 lakh crore in premiums. Private hospitals handle over 70% of India's healthcare services. Medical inflation runs at 15 to 20% annually. Over 73,000 health insurance complaints were registered on IRDAI's Bima Bharosa portal in FY 2025-26, up from 47,000 just two years earlier. Claim rejections surged 19% in a single year, with ₹15,100 crore disallowed in FY24 alone. Over 32% of reimbursement rejections in Q4 2025 were due to illegible discharge summaries. Only 47% of patients who received hospital bills found them to be fully itemized.

The information asymmetry here is three-sided. The hospital knows what it charged, what it should have charged, and what it can get away with. The insurer knows the policy terms, the exclusion clauses, and the regulatory requirements it is technically violating. The patient knows nothing. And the patient is the one standing at the billing counter with a family member who cannot leave.

The crisis is not that healthcare is expensive. It is that nobody in the system has an incentive to tell the patient what anything should actually cost.

What Exists Today

Ankit's current options:

Option A: Trust the bill. Pay the ₹1,93,000. Go home. Never know whether ₹80,000 of that was for phantom consultations and inflated consumables. This is what 90% of families do. They pay because their loved one is behind a door they cannot open until the bill is cleared. The hospital knows this. The entire billing model depends on it.

Option B: Argue at the counter. Ask the billing desk to explain each line item. The desk hands over a 12-page printout with abbreviations Ankit cannot decode. "ICU Consumables" appears as a single line for ₹67,000. No further breakdown. The person at the counter did not create the bill. They cannot explain it. They can only collect it.

Option C: File an insurance grievance. The insurer's grievance process takes 14 days. IRDAI escalation takes 7 more. The Insurance Ombudsman has 17 offices for 1.4 billion people. The insurer launched a claims chatbot in March 2026 that handles 30% of queries but cannot approve claims. It can only verify documents. Meanwhile, Ankit's father is still in the hospital.

Option D: Approach a consumer court. India's consumer courts have 5.15 lakh pending cases. Over 35% of cases at state commissions have been pending for more than three years. 50% of state commission president posts are vacant. 10% of India's districts do not have a consumer commission at all. The statutory mandate is a 3 to 5 month resolution window. The reality is years.

Option E: Google it. Search for "hospital overcharging India." Find generic advice: "demand an itemized bill," "know your rights," "file a complaint." None of this advice knows Ankit's specific policy terms, his father's specific diagnosis codes, the specific CGHS benchmark rates for the procedures performed, or the specific IRDAI regulation that makes half the insurer's rejection invalid. The advice is directionally correct and operationally useless.

Every existing solution fails in the same way. It either operates too slowly for the moment of crisis, or it requires expertise the patient does not have, or it addresses only one side of a three-sided problem. Nobody is simultaneously reading the hospital bill, cross-referencing it against benchmark rates, checking the insurance policy terms,

applying the current regulatory framework, and generating an actionable response that Ankit can use at the billing counter in the next 45 minutes.

The Contradictions That Matter

Here is where it gets interesting. Consider these real-world scenarios:

Scenario 1: Three prices for the same treatment.

The hospital bills ₹4,87,000. The CGHS benchmark for the same set of procedures totals approximately ₹1,80,000. The insurer settles at ₹2,94,000. Three numbers. None of them is derived from a transparent, standardized methodology. The hospital's number includes differential pricing for insured patients (hospitals routinely charge 30 to 40% more when insurance is present). The insurer's number reflects negotiated network rates plus sub-limits the patient never understood. The CGHS number was last revised in a previous cycle and may not reflect current costs. Which number is "right"? What does your system anchor its assessment to when no authoritative fair-price reference exists? Can you construct one from available data? What are the risks of doing so?

Scenario 2: The regulation overrides the policy.

The insurer rejects ₹1,93,000 citing "non-payable items per policy Schedule IV." But IRDAI's March 2026 guidelines introduced three new auto-decline triggers that are now invalid. Specifically: declaring any diagnosis as "not covered" after the 15-day settlement window elapses, failing to fill the claim form on IRDAI's unified portal within 3 working days of receipt, and any discrepancy between discharge summary and prescription sheet exceeding ₹10,000. The insurer's rejection letter cites the policy. The regulation overrides the policy. The patient does not know the regulation exists. Your system needs to reason not just about the policy document, but about the regulatory layer above the policy, and detect when one contradicts the other. Where does the regulatory knowledge come from? How do you keep it current? What happens when your system cites a regulation that has been superseded?

Scenario 3: Half the bill is verifiable, half is a black box.

Some line items on Ankit's bill can be objectively verified. Medicines have an MRP printed on the packaging. Diagnostic tests have published CGHS rates. Medical devices

like stents have NPPA price caps. But other line items are inherently opaque. "Specialist Consultation x 8" when only two doctors entered the room. "ICU Monitoring Charges" as a lump sum with no breakdown. "Nursing Charges" that vary by 400% across hospitals for the same acuity level. Your system has strong evidence for some dimensions and zero evidence for others. How do you represent partial confidence? If you can verify that 60% of the bill is inflated by 40%, what do you say about the 40% you cannot verify? Do you extrapolate? What are the risks of doing so? What are the risks of not doing so?

Scenario 4: The clock is ticking.

Ankit has approximately 45 minutes before the hospital's billing counter closes for the day. If he does not pay, his father stays another night, and the bill increases. Every existing remedy operates on a timeline incompatible with the moment of need: insurer grievance (14 days), IRDAI escalation (7 days), Ombudsman (weeks), consumer court (years). Your system is useful only if it operates at the speed of the crisis. This is not a "generate a report" problem. This is a "give me an actionable document in the next 10 minutes that I can hand to the billing manager" problem. What does that document look like? What legal citations does it need? What tone does it strike? Too aggressive and the hospital retaliates with delays. Too passive and they ignore it. How does your system calibrate this?

Scenario 5: Insurance makes the bill higher.

The same hospital charges ₹19,000 for a CT scan to an insured patient and ₹6,000 to a cash-paying patient for the identical scan on the identical machine. This is not fraud in any technical legal sense. It is differential pricing, a widespread practice in Indian private hospitals where the presence of insurance itself inflates the price. The insurance that was supposed to protect Ankit is the reason his father's bill is higher. Your system needs to reckon with the structural paradox that the tool meant to reduce patient cost is actively increasing it. How do you benchmark "fair" when the market has two entirely different price regimes for identical services? Should your system recommend that Ankit pay cash and file for reimbursement instead of using cashless? Under what conditions? What data would you need to make that recommendation responsibly?

Scenario 6: The discharge summary is the evidence, and the hospital wrote it.

The primary document your system needs to verify the bill is the discharge summary. But the discharge summary was written by the hospital. If the hospital inflated the bill, the discharge summary will reflect the inflated version. It will list all eight specialist

consultations. It will document the CT scan as medically necessary. It will show the ICU consumables as used. The document that should be the ground truth is authored by the party with the incentive to distort it. How does your system detect inconsistencies within a self-consistent but inflated narrative? Can you cross-reference the discharge summary against the prescription sheet, the nursing notes, the lab reports, and the pharmacy records to find contradictions? What if all of these are consistent because they were all generated by the same system?

Scenario 7: The emotional leverage is the product.

The hospital does not need to threaten Ankit. It does not need to be rude. It simply needs to say: "Sir, we cannot discharge your father until the outstanding balance is cleared. Our policy." That is all it takes. Every minute Ankit's father is inside, the emotional pressure to just pay increases. The hospital's business model does not depend on the bill being accurate. It depends on the bill being paid before the patient has time to question it. Your system is not just solving an information problem. It is operating against a business model that is specifically designed to prevent the patient from having time to think. How do you design for this? What does a system look like that shifts the power dynamic at the moment of maximum emotional vulnerability?

Each of these scenarios demands a different kind of reasoning. Some require document parsing and cross-referencing. Some require legal and regulatory knowledge. Some require price benchmarking against external datasets. Some require generating actionable outputs under extreme time pressure. Some require navigating the tension between what is technically legal and what is substantively fair. A system that handles only one of these is a toy. A system that handles all of them is a company.

Your Job

Solve Ankit's problem.

That is the entire brief. Everything below is here to help you think, not to tell you what to build.

Questions to Sit With Before You Design Anything

Do not skim these. Each question points at a design decision that will shape your entire solution. If you cannot answer a question clearly, you are not ready to build that part of the system.

On the nature of the data

A hospital bill arrives as a PDF, sometimes as a printout photographed on a phone, sometimes as multiple pages with abbreviations, procedure codes, and pharmacy line items. A discharge summary is a different document with a different structure. An insurance policy is a 40-page PDF with exclusions buried in Schedule IV. An IRDAI circular is a government notification in legalese. A CGHS rate card is a spreadsheet. A pharmacy MRP is printed on a strip of tablets. What does this tell you about your ingestion layer? Can a single parser handle all of them? What happens when the bill is a blurry photo taken under fluorescent light at 11 PM?

Medical billing data is not just unstructured. It is adversarially structured. The opacity is not accidental. "ICU Consumables" as a single ₹67,000 line item is a design choice by the hospital's billing system. It is structured just enough to look legitimate and just vague enough to resist scrutiny. Your system needs to identify not just what the data says, but what it is hiding by how it chooses to aggregate.

On the knowledge your system needs but does not have in the input

Your system needs to know things like: "The CGHS rate for a CT scan of the chest in a metro city is ₹2,500." "NPPA has capped the price of drug-eluting stents at ₹30,000." "Under IRDAI's 2025 health claim rules, the insurer must settle within 15 calendar days of receiving the final discharge summary." "Metformin 500mg is available at ₹2.5 per tablet; the hospital charged ₹12." This knowledge comes from at least four different domains: clinical benchmarking, pharmaceutical pricing, insurance regulation, and consumer law. Where does each come from? How does your system access it at the right moment? What happens when the CGHS rate card is two years old? What happens when your system cites a regulation that was amended last month?

When your system flags a line item as inflated, it is making a claim with financial and potentially legal consequences. If the claim is wrong, it could undermine Ankit's

credibility with the hospital. If the claim is right but unsupported by evidence, it is an opinion, not a finding. How do you ensure your system is actually using what it retrieved and not generating plausible-sounding medical pricing information? How do you distinguish between "this line item is inflated because I have benchmark data" and "this line item looks suspicious but I have no reference point"?

On trust and confidence

If your system can verify 7 out of 12 major line items on the bill and finds that 5 of the 7 are inflated by 40% or more, what should it say about the remaining 5 line items it could not verify? The temptation is to extrapolate: "If 70% of what we can check is inflated, the rest probably is too." But that is an inference, not evidence. How does your system represent partial confidence without losing the power of what it did find?

A bill where every line item can be verified and 3 are inflated versus a bill where only 2 line items can be verified and both look clean: which bill should Ankit worry about more? What does this tell you about how you represent trust? Is a bill with more verifiable data points always more trustworthy, or does the unverifiable portion carry its own risk signal?

When the discharge summary says one thing and the bill says another (for example, the summary lists two specialist consultations but the bill charges for eight), what should the output reflect? A flag? A calculated overcharge amount? A confidence-weighted estimate? What if the discharge summary was written to match the bill?

On the three-party problem

Ankit's problem involves three parties: the hospital, the insurer, and himself. The hospital wants to maximize the bill. The insurer wants to minimize the payout. Ankit wants to minimize his out-of-pocket cost. Each party has different information, different incentives, and different power. Most existing tools serve one party. Hospital billing software serves the hospital. Claims processing systems serve the insurer. Your system serves the patient. What does it mean to build a system that serves the weakest party in a three-sided negotiation? What information does it need from each of the other two parties? What happens when one of them does not cooperate?

The insurer's rejection might be partially legitimate (some items genuinely are not covered) and partially illegitimate (some items are covered but rejected anyway). Your system cannot just be "anti-insurer" or "anti-hospital." It needs to distinguish between

valid and invalid charges on the bill, and between valid and invalid rejections by the insurer. This requires reasoning about two different sets of rules simultaneously: hospital pricing fairness and insurance policy compliance. How do you prevent your system from becoming a blunt instrument that flags everything as overcharged or every rejection as wrongful?

On time pressure and output design

Ankit is not a researcher. He is a man standing at a counter. He needs three things: What is wrong with this bill? What should I do right now? What document do I hand to whom? Your system's output is not a report. It is a weapon. It needs to be precise enough to be credible, simple enough to be understood, and structured enough to be actionable. What does that look like?

If your system generates a formal objection letter citing IRDAI regulations and CGHS benchmark rates, who does Ankit give it to? The billing manager? The hospital's grievance cell? The insurer's claims department? Each recipient requires a different document with different content, different tone, and different legal framing. Does your system generate one output or three? What happens if Ankit gives the wrong document to the wrong party?

If your system is uncertain about its analysis (say, it could verify only 4 of 12 line items, and the benchmark data for 2 of them is from a rate card that is 18 months old), should it present its best case confidently, or surface the uncertainty? What does Ankit lose in each case? If the system is confident and wrong, Ankit loses credibility. If the system is uncertain and transparent, Ankit loses leverage. How do you calibrate this for someone who has 45 minutes and a father behind a locked door?

On structure and resilience

If tomorrow IRDAI mandates that all hospitals must submit bills in a standardized digital format through a unified portal (they have already started requiring QR codes at reception desks as of April 2026), how much of your system would you need to rewrite to incorporate this structured data source? What does your answer tell you about how your system should be structured?

If the CGHS rate card is unavailable, does your system fail entirely, or degrade to a still-useful mode? If the insurance policy document is a scanned image rather than a searchable PDF, what happens? If the hospital bill is in Hindi or a regional language,

what happens to your parsing layer? If Ankit's specific policy was issued by a small insurer with non-standard terms, what happens to your regulatory reasoning?

Your system needs to improve over time. Every bill it analyzes is a data point about hospital pricing patterns. Every rejection it reviews is a data point about insurer behavior. Every outcome it tracks is a signal about what works. How do you design the system so that the hundredth bill it analyzes is better understood than the first? What data do you retain? What privacy constraints apply?

On the person reading the output

Ankit is stressed, scared, and possibly angry. He has been standing in a hospital corridor for three days. He has not slept well. He does not understand medical billing codes. He does not understand insurance policy language. He does not understand legal terminology. He needs to know: Am I being overcharged? By how much? What can I do about it right now? If your system gives him a 15-page analysis with confidence intervals and regulatory citations, he cannot use it. If your system gives him a one-line answer with no supporting evidence, he cannot trust it. Where is the right level?

When your system surfaces a potential overcharge, how do you communicate it to someone who is not a medical billing specialist, not an insurance expert, and not a lawyer? If you oversimplify, you strip away the evidence Ankit needs to challenge the hospital. If you use technical language, you create confusion without understanding. The output design is not a UX problem. It is a communication problem under duress.

If your system finds that ₹1,40,000 of the ₹1,93,000 the hospital is demanding appears unjustified, but you are only 70% confident in that number, should you tell Ankit "you are being overcharged by approximately ₹1,40,000" or "you may be overcharged by ₹98,000 to ₹1,40,000" or "several line items appear inflated; here are the specific ones we can document"? Each framing leads to a different action. Each carries different risks. What is the design of honesty that preserves agency under pressure?

Why This Matters Beyond the Capstone

Consider the numbers. ₹15,100 crore was disallowed in health insurance claims in a single year. 73,000 formal complaints were filed, each representing a family that knew enough to complain. The families who did not know, who simply paid, who walked away from money that was legally theirs: millions. If a system could recover even 10% of unjust rejections, that is ₹1,500 crore flowing back to families. Per year.

Consider the incentives. The insurer wants to reject fewer claims (IRDAI is fining them, with ₹1.2 crore levied against a single insurer for 182 delayed settlements). The hospital wants fewer disputes (consumer court cases are increasing). The patient wants to understand their bill. Everyone in the system has a reason for this tool to exist. Nobody has built it because it requires simultaneous reasoning across medical knowledge, insurance policy terms, regulatory frameworks, hospital billing patterns, and real-time price benchmarks. That intersection is exactly the kind of multi-source, multi-format, contradiction-resolving system that this capstone series is designed to teach you to build.

The student who solves this well does not have a capstone project. They have a product that every insurance company, every hospital chain, every consumer rights organization, and every one of the 550+ million Indians covered by health insurance would use. The total addressable market is the entire Indian healthcare billing system. The moat is the reasoning layer that no single existing tool covers.

Build it like it matters. Because it does.