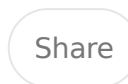
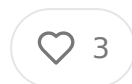


Threading the Needle: Building Pre-Payment Claims Validation Infrastructure in the Last Mile of Healthcare Payments

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Abstract

The payment integrity market represents a substantial opportunity within health technology, with approximately four hundred billion dollars in improper payments occurring annually across commercial and government payers. This essay examines the technical architecture and go-to-market strategy required to build a pre-payment claims validation startup focused on medical record review after adjudication but before payment disbursement. The analysis covers integration patterns with core adjudication platforms, the architectural requirements for automated medical record retrieval and analysis, and the channel partner strategy necessary to reach payer organizations efficiently. Key technical considerations include building robust API integrations with legacy systems, designing scalable document processing pipelines, maintaining strict audit compliance, and creating compelling economic models to align incentives across all stakeholders in the payment ecosystem.

The Cathedral and the Bazaar of Healthcare Payments

The healthcare payment system in the United States processes approximately three trillion dollars annually, moving through a complex choreography of claims submission, adjudication, and payment that touches hundreds of millions of transactions. Within this enormous flow of capital lies a persistent problem that vexed payers, providers, and patients for decades: ensuring that payments accurately reflect the services actually rendered and the contractual obligations between payer and provider. While most technology innovation in healthcare has focused on the front end of the process, specifically claims submission and initial adjudication, a significant opportunity exists in the liminal space between adjudication approval and actual payment disbursement.

This window, typically lasting between three and fourteen days depending on payer policies and payment cycles, represents the last opportunity for systematic intervention before funds leave the payer's control. Traditional payment integrity programs have operated primarily in two modes: pre-adjudication edits that apply rules-based logic to identify obviously problematic claims, and post-payment recovery efforts that attempt to reclaim funds after disbursement. The former catches only the most egregious errors that can be detected without clinical context, while the latter suffers from the practical difficulties of clawing back money that has already been paid, creating provider friction and requiring substantial resources for appeals and disputes.

The technical architecture required to operate effectively in this pre-payment window demands a sophisticated understanding of both healthcare data systems and enterprise software integration patterns. Unlike many healthcare technology startups that can operate primarily as standalone applications with simple data imports and exports, a pre-payment validation system must integrate deeply with the operational core of payer organizations, specifically their claims adjudication platforms. These systems, often decades old and running on mainframe or legacy enterprise architectures, represent some of the most mission-critical infrastructure in healthcare, processing claims worth millions of dollars daily with stringent uptime requirements and regulatory compliance obligations.

The fundamental technical challenge begins with understanding how modern adjudication platforms actually work. The major players in this space include systems like Facets from Optum, Claim IQ from HealthEdge, and various homegrown platforms built by large national and regional payers over the past thirty to forty years. These systems typically operate in batch processing modes, ingesting claim files through standardized formats like ANSI X12 837 electronic data interchange transactions, applying complex rule engines and contract logic, and producing adjudication decisions that flow into payment files. The architecture generally follows a layered approach with distinct separation between claims intake, eligibility verification, benefit determination, pricing application, and payment authorization.

To insert a pre-payment validation step into this flow requires identifying the precise point in the adjudication pipeline where claims have been fully processed and approved for payment but have not yet been transmitted to the payment systems. The integration point varies significantly across different adjudication platforms and implementations. Some systems maintain a clean separation between adjudication engines and payment systems with well-defined handoff points, while others have tightly coupled architectures where the adjudication decision and payment authorization happen in a single transactional flow. Understanding these architectural patterns requires deep technical discovery work with each potential payer customer: examining their system diagrams, data flow documentation, and often conducting detailed interviews with their technical teams to map out the actual implementation.

The integration pattern that emerges from this discovery typically involves one of three architectural approaches. The first approach, which works best with more modern systems that expose robust APIs, involves subscribing to event streams or webhook notifications when claims reach the approved-for-payment state. These claims can then be extracted through API calls that provide the complete claim data, including all line items, diagnosis codes, procedure codes, provider information, and adjudication results. This approach offers the advantage of real-time processing and a clean separation of concerns, allowing the validation system to operate as a distinct service without requiring deep coupling to the adjudication platform internals.

The second approach, more common with legacy systems that lack modern API infrastructure, involves direct database access through scheduled extract processes. In this pattern, the validation system receives periodic batch files containing all claims that have moved into the approved-for-payment queue since the last extraction. Files typically come in flat file formats or through database views that expose the necessary claim attributes. The validation system processes these batches, performs its analysis, and returns decision files that flag claims requiring hold status and medical record review. The adjudication system then consumes these decision files and updates claim statuses accordingly. While less elegant than real-time event-driven architecture, this approach has the significant advantage of working with virtual adjudication platforms regardless of age or technical sophistication.

The third approach, which represents a hybrid model increasingly common in enterprise healthcare IT, involves implementing a service bus or integration middleware layer that acts as an intermediary between the adjudication system and the validation platform. Technologies like MuleSoft, Informatica, or HealthShare/InterSystems often already exist within large payer organizations to handle integration between various systems. Leveraging these existing integration platforms can significantly reduce implementation complexity and security concerns, as the validation system can communicate with the established middleware rather than directly with the adjudication system. This approach also provides better operational characteristics around monitoring, logging, and error handling, as these capabilities are typically built into enterprise integration platforms.

Regardless of the specific integration pattern employed, several technical requirements remain constant. The validation system must be capable of processing claim volumes that can range from thousands to millions of claims per day depending on payer size. Performance requirements typically demand that the system can make initial screening decisions within seconds to avoid becoming a bottleneck in the payment workflow. For claims that require deeper analysis or medical record retrieval, the system needs to implement sophisticated workflow management that can track request status, manage timeouts, escalate issues, and ultimately produce clear approve or deny recommendations within the payer's payment cycle timeframe.

The data model for the validation system needs to accommodate the full complexity of healthcare claims, which means supporting both institutional claims with potentially hundreds of line items and professional claims with their own distinct data requirements. Each claim line item contains procedure codes from CPT, HCPCS or other coding systems, diagnosis codes from ICD-10-CM, modifiers that affect how procedures are interpreted, and place of service codes that provide context about where care was delivered. The validation logic needs access to all of this data plus adjudication results including allowed amounts, patient responsibility calculations and any adjustments or denials applied to individual line items.

Beyond the raw claim data, effective validation requires access to substantial contextual information. This includes the patient's full eligibility and benefits history, previous claims for the same patient to identify patterns or related care episodes, provider credentialing and network status information, and contract terms that govern payment rates and policies. Many adjudication systems store this contextual data across multiple database tables or even separate systems, requiring the integration architecture to pull from multiple data sources to assemble a complete picture for validation purposes.

The medical record retrieval component of the system presents its own substantial technical challenges. When the validation logic identifies claims that require additional clinical documentation for review, the system needs to initiate automated medical record requests to the rendering providers. This process involves several distinct technical capabilities starting with provider contact information lookup. While claims contain provider identifiers like National Provider Identifiers, they lack current contact details for medical records departments. Building and maintaining a comprehensive provider directory with medical records contact information, preferred submission methods, portal credentials, and historical response patterns represents a significant data management challenge in itself.

The record request process needs to support multiple delivery channels depending on provider preferences and capabilities. Some providers maintain patient portals or provider portals that support programmatic record requests through APIs or web form automation. Others require fax-based requests sent to specific numbers with

carefully formatted cover sheets and request details. Still others prefer secure email with specific subject line formats and attachment requirements. The system architecture needs to support all of these channels while maintaining detailed audit logs of every request, response, and follow-up interaction to satisfy regulatory requirements around record requests and reviews.

Once medical records arrive, whether as scanned PDFs, faxed images, or structured electronic documents, the system must implement sophisticated document processing pipelines. Optical character recognition technology handles conversion of image-based documents into searchable text, but healthcare records present unique challenges due to handwritten notes, poor scan quality, complex table structures, and specialized medical terminology. Modern approaches increasingly incorporate machine learning models trained specifically on medical documents to improve extraction accuracy, but substantial engineering work remains necessary to handle the long tail of document formats and quality variations encountered in real-world operations.

The clinical review component requires building workflow management systems that route cases to qualified reviewers, typically registered nurses or physicians, who evaluate whether the medical records support the services billed on the claims. The workflow system needs to present reviewers with the claim details alongside the medical records in an intuitive interface that allows rapid assessment while capturing detailed findings and rationales. The system must track reviewer productivity metrics to support quality assurance processes where senior clinicians audit a sample of decisions, and produce comprehensive documentation that can support appeals if providers dispute the payment decisions.

Audit trail and compliance requirements permeate every aspect of the system architecture. Healthcare data handling falls under HIPAA regulations requiring detailed logging of all access to protected health information. Payment decisions that affect provider reimbursement need clear documentation trails that can demonstrate the clinical and policy rationale behind each determination. Many state regulations impose additional requirements around transparency and provider notification if payment is denied. The system architecture needs to build in comprehensive logging

secure audit trail storage, and reporting capabilities from the foundational layer rather than attempting to retrofit compliance features later.

Security architecture deserves particular attention given the sensitivity of the data involved and the integration touchpoints with payer systems. The system must implement defense-in-depth strategies including network segmentation, encrypted data transmission and storage, role-based access controls, and regular security audits. Penetration testing and vulnerability assessments become table stakes for earning trust with enterprise payer customers who face enormous potential liability from breaches. Many large payers will require SOC 2 Type 2 attestation or HITRUST certification before they will consider allowing integration with their core systems, making these compliance frameworks essential rather than optional for a startup in this space.

The technical architecture also needs to address disaster recovery and business continuity requirements. Because the validation system sits in the critical path of the payment workflow, any extended downtime directly impacts payer operations and provider payment cycles. This demands building redundancy into every layer of the system including multiple availability zones for compute resources, database replication across geographic regions, and documented failover procedures. The system needs comprehensive monitoring and alerting that can detect and notify system engineers of issues before they impact operations. Recovery time objectives typically need to be measured in minutes rather than hours, requiring significant investment in infrastructure automation and incident response procedures.

The channel partner go-to-market strategy for this type of startup fundamentally differs from typical software-as-a-service approaches. The core adjudication platform vendors represent natural channel partners because they already maintain deep relationships with payer customers and often serve as strategic technology advisors. Vendors like Optum, HealthEdge, Change Healthcare, and others operate extensive professional services organizations that help payers implement and optimize the platforms. Positioning the validation solution as a complementary capability that enhances the value of these core platforms, rather than as a competitive threat, becomes essential for building productive partnerships.

The economic model for channel partnerships needs to align incentives carefully. Most adjudication platform vendors operate on a combination of licensing fees and transaction-based pricing, with professional services representing another significant revenue stream. A validation solution could integrate into this model through several approaches. Revenue sharing arrangements where the validation startup receives a percentage of fees earned on validated claims represents one model, though it requires careful negotiation to ensure all parties receive adequate compensation. Alternatively, the validation solution could be positioned as a premium add-on module with separate pricing that the platform vendor markets to its customers, the vendor receiving a referral fee or reseller margin.

The value proposition to platform vendors needs to emphasize how the validation capability strengthens their competitive position and customer relationships. Platforms face constant pressure to improve payment accuracy and reduce administrative costs while maintaining or improving provider satisfaction. A validation solution that demonstrably reduces improper payments without creating significant operational burden or provider friction provides tangible value that adjudication platform vendors can highlight in competitive sales situations and customer renewal discussions. The startup needs to develop clear ROI models and case studies that platform vendor sales teams can present to prospects and customers.

Building these channel relationships requires patience and sophisticated partner management capabilities. Enterprise software sales cycles in healthcare commonly extend twelve to eighteen months, and channel partner relationships can take equally long to establish and operationalize. The startup needs to invest in partner enablement materials including technical integration guides, sales training content, joint customer success processes, and co-marketing programs. Regular executive engagement between the startup leadership and partner executives helps maintain alignment and resolve issues that inevitably arise as the partnership scales.

The technical integration with platform vendors extends beyond just the claims integration to include joint roadmap planning, shared support escalation processes, and coordinated release management. When the adjudication platform releases a major version upgrade or changes API specifications, the validation solution needs

adapt accordingly. This requires maintaining close communication with partner engineering teams and often participating in early access programs to test compatibility before changes reach production customers. The startup needs to dedicate engineering resources specifically to partner technical relationship management rather than treating it as an afterthought.

An alternative or complementary go-to-market approach involves building direct relationships with system integration firms and consulting organizations that help payers implement and optimize their technology stacks. Companies like Cognizant, Accenture, and specialized healthcare IT consultancies often lead major transformation projects for payers that might include implementing new payment integrity capabilities. These firms can serve as influential advisors who recommend solutions to their payer clients. Positioning the validation platform as a recommended component in these transformation programs requires building relationships with practice leaders and demonstrating that the solution integrates cleanly with the broader architecture being implemented.

The startup also needs to consider how the solution fits into the broader payer payment integrity ecosystem. Most large payers already employ multiple payment integrity vendors and capabilities covering different aspects of the problem from pre-payment edits to post-payment audits to fraud detection to utilization management. The validation solution needs to complement rather than replace these existing capabilities, which means developing clear positioning around the specific claim scenarios where medical record review before payment provides maximum value. These might include high-dollar outlier claims, claims with specific procedure combinations that warrant clinical validation, or claims from providers with concerning utilization patterns.

Developing this positioning requires deep analysis of actual claims data to identify opportunity space where pre-payment validation generates the highest return. A typical large commercial payer might process fifty million claims annually with total payments of twenty billion dollars. Of these claims, perhaps one to three percent represent potential improper payments totaling two hundred to six hundred million dollars. The validation solution cannot economically review every claim, so the

challenge becomes identifying the subset where medical record review is likely to yield savings and the expected savings justify the review cost. Sophisticated predictive models using machine learning techniques can help prioritize claims for review based on historical patterns, but building these models requires access to substantial training data from actual payer operations.

The implementation roadmap for a startup pursuing this opportunity needs to balance several competing priorities. Building deep integration capabilities with major adjudication platforms requires significant engineering investment and long sales cycles before generating revenue. Starting with a more limited integration approach using batch file exchanges can accelerate time to market but may limit solution's appeal to larger, more sophisticated payers who prefer real-time architectures. The roadmap decision often comes down to initial customer target with smaller regional payers potentially more willing to accept batch-based approaches while large national payers demand more sophisticated integration.

The medical record retrieval and analysis capabilities represent another major roadmap consideration. Building fully automated record retrieval with support for multiple delivery channels and comprehensive provider coverage requires substantial operational infrastructure beyond just software development. Many startups in this space initially implement manual or semi-automated processes where staff handle provider outreach and coordinate record receipt, then gradually automate components as volume scales. This approach allows faster market entry but requires careful cost management to avoid operational expenses consuming all gross margin before automation delivers efficiency.

The clinical review capability presents a similar build-versus-buy decision. Some startups choose to build in-house clinical teams of nurses and physicians who perform the actual medical necessity reviews, providing complete control over quality and process but requiring expertise in clinical recruiting, training, and management. Others partner with existing medical review organizations that already employ clinical staff and handle the review workflow, allowing the startup to focus on the technology platform and integration capabilities. Each approach has merits depending on the founding team's background and the specific market positioning chosen.

The startup must also navigate complex regulatory and compliance landscapes that vary across states and payer types. Medicare Advantage plans face different rules than commercial plans regarding payment holds and medical record requests. Medicare managed care organizations operate under state-specific regulations that can vary dramatically in their requirements. Building a platform that can accommodate these variations without becoming an unmaintainable morass of conditional logic requires careful architecture planning and often means implementing a rules engine that allows configuration of different workflows and policies for different customer segments.

Provider experience considerations deserve explicit attention in the solution design. While the primary customer is the payer, the solution's operations directly affect providers through medical record requests and potential payment holds. Providers already face substantial administrative burden from payers, and a validation solution that adds significantly to this burden will generate pushback that ultimately threatens the solution's viability. The system needs to implement provider-friendly features: consolidated record requests that batch multiple claims into single requests, clear communication about specific documentation needed, reasonable timeframes for response, and straightforward appeal processes when providers disagree with determinations.

The competitive landscape for payment integrity solutions is crowded but fragmented, with different vendors specializing in different aspects of the problem. Established players like Cotiviti, ProgenyHealth, and others have built substantial businesses in post-payment recovery and specific payment integrity niches. New entrants often focus on applying machine learning or artificial intelligence to improve detection accuracy or reduce manual review requirements. The pre-payment validation space specifically has seen growing interest as payers recognize the advantages of catching issues before payment versus after, but no single vendor has established dominant market position. This fragmentation creates opportunity for a well-executed startup but also means carefully differentiating from the many potential solutions already in market.

The unit economics of the business require careful modeling to ensure the solution can be profitable at scale. A typical pricing model might charge payers a percent of savings identified, often in the range of fifteen to thirty percent of prevented improper payments. For a large payer preventing one hundred million dollars in improper payments annually, this could generate fifteen to thirty million dollars in revenue. However, the costs of operating the solution including clinical review labor, medical record retrieval expenses, technology infrastructure, and customer support need to be factored against this revenue. The gross margin profile typically improves as automation increases and as the solution learns which claim patterns most often result in findings, allowing more targeted review efforts.

Customer acquisition costs in enterprise healthcare software commonly reach hundreds of thousands of dollars per customer when accounting for sales, marketing, and implementation expenses. With annual contract values potentially ranging from hundreds of thousands to millions of dollars depending on payer size, the payback period on customer acquisition might extend one to three years. This demands patient capital willing to fund growth through substantial losses in early years before the customer base reaches the scale needed for profitability. Many successful health IT companies have required seven to ten years and multiple funding rounds before achieving sustainable profitability.

The talent requirements for building this type of startup extend across several specialized domains. Engineering talent needs to include expertise in healthcare standards, enterprise integration patterns, document processing and optical character recognition, machine learning for claim prioritization, and secure, scalable infrastructure. Product management needs deep understanding of payer operations, payment integrity workflows, and regulatory requirements. Clinical expertise for developing review protocols and training review staff demands recruiting from the nursing and physician communities. Sales and customer success for enterprise healthcare requires professionals with existing payer relationships and credibility. Building a team with all these capabilities while maintaining startup velocity and culture presents one of the most significant execution challenges.

Looking forward, several technology trends seem likely to influence the evolution of pre-payment validation solutions. The continuing advancement of large language models and natural language processing creates opportunities for more sophisticated automated review of medical records, potentially reducing the need for manual clinical review on many claims. However, the high stakes nature of payment decisions and the need for defensible rationales will likely mean human oversight remains necessary for the foreseeable future even as automation improves. The gradual modernization of adjudication platforms and increasing adoption of API-driven architectures should make integration somewhat easier over time, though the pace of change in core payer systems tends to be measured in years rather than months.

The consolidation trends in the payer industry affect go-to-market strategy as the number of distinct payer organizations decreases but average size increases. Fewer customers means each sale becomes more critical and winner-take-all dynamics emerge where a few payment integrity vendors capture most of the market. This accelerates the importance of channel partnerships with adjudication platform vendors who can provide access to their entire customer bases. It also increases the stakes around customer success and retention since losing a large payer customer could meaningfully impact company revenue and growth trajectory.

The regulatory environment continues to evolve with increasing focus on healthcare price transparency, payment accuracy, and reducing the overall cost of healthcare. Government programs like the Medicare Fee-For-Service Recovery Audit Contractor program demonstrate ongoing commitment to payment integrity, and commercial payers face parallel pressures from employer customers demanding better cost management. This regulatory and market pressure creates favorable tailwinds for payment integrity solutions generally, but also means the bar for demonstrating value continues to rise as payers become more sophisticated in their evaluation of which solutions actually move the needle.

Building a successful startup in this space ultimately requires balancing technical sophistication with practical business considerations. The temptation to build the most elegant, fully-automated, AI-powered solution needs to be tempered by the reality that healthcare moves slowly and customers need to see tangible value quickly.

Starting with claims scenarios where the solution can demonstrate clear ROI using relatively straightforward technology, then expanding capabilities over time as the technology and revenue grow, often proves more successful than attempting to boil the ocean from day one. The founders who succeed in this space typically combine deep domain expertise, patient capital, strong execution capabilities, and the resilience to navigate the inevitable setbacks that come with enterprise software in healthcare.

The opportunity remains substantial for startups that can navigate the technical and business complexities. The magnitude of improper payments in healthcare means capturing a small percentage of the addressable market can build a significant business. The increasing sophistication of data analytics, the gradual modernization of payer systems, and the ongoing pressure for cost reduction all create favorable conditions for innovation in this space. For technical founders with the patience and expertise to build deep integrations with core payer systems while delivering measurable value, pre-payment claims validation represents a compelling opportunity to build meaningful technology that improves the efficiency and accuracy of healthcare payment at scale.



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