Artificial Intelligence in Healthcare Claims Processing: Automating Claim Validation and Fraud Detection

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Abstract

This paper describes the development and use of artificial intelligence tools that were created to solve this industry issue. These models provide a rigorous check of the claims information and identify fraud through recognizing the affiliation and interaction of the parties constituting the claim (patient, providers and insurance company/insured), as well as the service and diagnosis codes. This paper shows that it is possible to predict claim denials using information freely available to providers, a fact that would allow them to make better decisions with regard to their claims and the financial health of their organizations. These models can provide a new view on enhancing the claims management and will contribute to the decrease of the number of denied claims. It was stated that currently Medicare fee-for-service claims have been denied annually approximately 10 percent which places a heavy burden on both administration and financial aspects of care delivery settings. It is crucial that a proper denial management plan be put in place to assess the major reasons of denied claims so as to have better chances of initial payment of a claim [1]. However, because of the high incidence of claims and a scarcity of funds to deal with denials, the issue of priorities in the allocation of funds becomes pertinent. In this work, several categories of machine learning models are built to determine the likelihood of a given claim to be denied prior to being filed, and the datasets comprise both the provider and beneficiary levels. These solutions assist in ensuring that health claims are processed effectively and efficiently hence reducing costs to the payers as well as the providers. It has been observed that the incorporation of these AI models has helped in claim processing reductions hence increasing on efficiency levels of patients. Moreover, with the help of the machine learning techniques used, the models get more efficient in recognizing fake claims that leads to a more efficient and sustainable healthcare system. Currently, approximately $180 billion is channelled towards insurance claims processing in the United States' health insurance industry alone [1,2]. These costs are primarily a direct result of the significant activity in administratively verifying the claims' correctness. Nevertheless, the largest costs are associated with the fact that up to 35% of payments are considered incorrect. It incorporates omission of correcting errors in underpayments and overpayments, rejection of benefits among others. Failures in payments most of the time arise from eligibility, referrals, authorizations, and utilization. Their higher susceptibility to fraud means a higher percentage of the estimated between $11 and $54 billion in the industry annually belongs to incorrect payments. This has largely been due to the escalating rates in healthcare costs and the ever-growing public expectations to offer better services while combating the act of fraud. The decision and management of such corrective action rest squarely on the payers'

shoulders [2]. Unleashing Evidence-Based Medicine Review: Close to 90% of the administrators and other employees of the healthcare entities report that they spend a lot of their time dealing with the different administrative and financial issues. The reimbursement of healthcare claims is one of the most expensive and time-consuming activities that both the payers and the providers experience on a routine basis. Employers usually invest huge sums of money to process claims and even then, the majority of the claims payments are inaccurate.

Keywords: Healthcare Claims Processing, Medicare, Batch Processing, Error Reduction, Technology, Artificial Intelligence (AI), Machine Learning (ML), Blockchain, Claims Automation, Data Validation

1. Introduction

Artificial Intelligence (AI) technologies, such as rule-based expert systems, neural networks, and machine learning, have the potential to increase the efficiency and decrease the costs of revenue cycle management by automating claims processing functions that currently rely on human expertise to verify and validate claims and detect fraudulent behavior. In this chapter, we discuss the use of AI in healthcare claims processing to perform claim validation and fraud detection of the medical and hospital services typically covered by health insurance. AI technology can be used in three main areas of healthcare claims processing: (1) automating claim validation by utilizing a pre-adjudication claim system harnessing both machine learning and rules-based reasoning; (2) detecting fraud in healthcare claims using unsupervised machine learning techniques; and (3) evidence-based post-payment auditing of provider claims using rule-based expert systems that "learn" by exploiting patterns discovered by machine learning [3]. Revenue cycle management is described as the process of tracking the revenue from patient encounter to receipt of payment, with the broad goal of healthcare financial management to "provide the needed cash to operate effectively and to make a profit." Healthcare organizations invest in revenue cycle management to maximize their income, but the administrative costs of these investment decisions flow in two opposite directions [4]. Costs can be reduced by standardizing and controlling patient flow, and by focusing on the decision points and information flows necessary to process the actual services delivered. At the same time, rising administration and information processing costs can result from increased regulation and oversight related to healthcare claims transactions and increasing the internal and external information flows related to the exchange of financial and clinical data [4].

While several insurers are experimenting with various AI technologies working as adjuncts to their existing business process management and rules engines, the vision of the near future is for the disruptive utilization of AI as the sole technology. This vision is for a totally flexible and adaptive system that requires no business process re-engineering to derive full benefits and one that can immediately start learning from its environment using advanced data mining and agent-based systems [4]. Given the advances in technology and the relatively small step most organizations would need to take with their current infrastructure to start utilizing AI, this vision can become reality sooner than is expected. The main contributions of this paper are the proposals for increased automation at lower cost of healthcare claim processing using AI technologies, and the outlining of a framework to undertake this in an organized manner. The technologies can be utilized by any healthcare and health insurance organization that uses a repository of rules for processing claims. Healthcare claims processing involves validating the claim against the policy terms, enrollment of the claimant from the repository of policyholders and beneficiaries, and ultimately processing the claim for payment. Increasing the

automation in this area has been the focus for several companies for quite some time, resulting in numerous technologies, such as business process management and rules engines, being utilized. This paper proposes the utilization of artificial intelligence as both a further enabler and a disruptive technology for increased automation of healthcare claims processing [4,5]. By using an AI platform and agent-based systems for different components of the validation and processing of a claim, it is argued that considerable improvements can be made. These improvements are in the areas of quicker fraud identification and validation of honest claims, increasing the percentage of claim processes that are fully automated, and reducing the personnel time and cost for the remaining manual interventions.

2. Research Problem

The main research problem in this study is to assess the utilization of artificial intelligence as both a further enabler and a disruptive technology for increased automation of healthcare claims processing. Unvalidated healthcare claims can lead to significant financial losses for the relevant stakeholders. Despite the bearing of the responsibility for such validation, a secondary review or formal decision regarding the claims, all healthcare administrators around the world, the relevant healthcare authorities, and the officers of the private health insurance companies perform the task manually. Fraud detection in healthcare claims has become increasingly necessary. In an atmosphere of budget constraints, the validation of healthcare claims has become more pertinent for healthcare administrators [5]. The current burden on healthcare administrators for the manual processing of non-validated claims and the double review is a significant issue, especially for the reimbursement of claims for fee-for-service healthcare, as it increases the likelihood of healthcare claim fraud. with large data sets. At the administrative level, processing healthcare claims remains a human task around the world. This research explores how machine learning can validate healthcare claims and be applied in fraud detection with such unstructured information. To address the research problem, a solution framework was developed and implemented that allows for a sentence-like representation of a claim in a knowledge base to produce an optimized query for claim validation. Four machine learning models were adopted to validate the claims, and a fake healthcare claim research database was utilized. Based on the validation of the model, a study of the size of fraud that the fraud detection model can effectively address was conducted[6,7].By using an AI platform and agent-based systems for different components of the validation and processing of a claim, it is argued that considerable improvements can be made. These improvements are in the areas of quicker fraud identification and validation of honest claims, increasing the percentage of claim processes that are fully automated, and reducing the personnel time and cost for the remaining manual interventions.

3. Literature Review
A. Artificial Intelligence in Claims Processing

Claims processing is the process where the patient seeks attention from a healthcare provider due to the symptoms or a diagnosis, and the provider is compensated for the specific services offered. Healthcare claims are a reimbursement form which is the administrator's request for reimbursement by the insurance firm or by the patient if he or she is a cash paying patient. In the sphere of healthcare [7], AI is currently in a unique opportunity to adapt the methods that aim at enhancing precision and orienting on the safety of patients. But different tasks of the healthcare field which includes an important area such as the claims processing; little did specify the application of different AI technologies. Automated claims processing can make a world of difference to the claims processing system and bring the doctors and other health care providers their rightful dues, faster, with a minimal amount of fuss or botheration from

the patient's side. It can assist in detecting mistakes or even fraudulent claims that would contribute to the insurers' saving more and enhance the efficiency of the claims process. It can also handle repetitive procedures; therefore, its effects enable the staff to deal with other crucial matters efficiently. In fact, the use of such AI technologies has to be prioritized by the healthcare providers, and adequate staffing and training needs to be provided to the staff to make the most of it in the claims processing. To determine when AI can play a role in claims processing and what its effects on the total performance of a healthcare organization might be, knowledge of the different spheres of activities of such organizations is needed [8].

Given the opportunity, commercial insurance companies would prefer to drastically reduce their administrative costs. Let's face it, these companies are in business to make profits. One of the major expense items is processing healthcare claims. Advances in artificial intelligence make it possible to automate much of the work involved in adjudicating and processing claims. Smart systems can validate a claim against the benefits provided by the policy being held, and then determine the cost and issue payment. Equally important, if not more so, is the ability of AI systems to detect fraud. It is estimated that upwards of 10 percent of all claims are fraudulent [9]. The cost of this fraudulent activity is in the billions of dollars. Clearly, the development and deployment of AI-based systems can significantly reduce the cost of claims processing for commercial insurance companies.
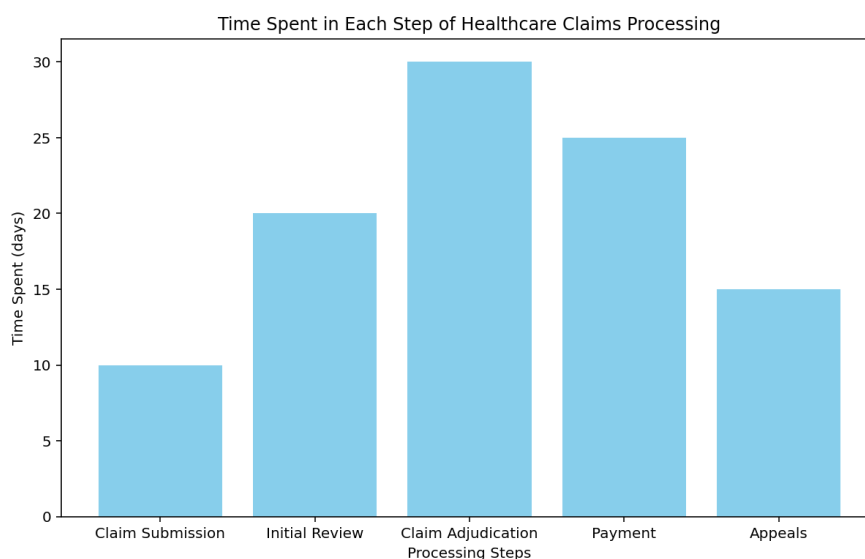

Fig. 1 ITime Spent in Each Step of Healthcare Claims Processing

B. AI in Healthcare Claims Processing

The adoption and implementation of AI in healthcare claims processing will require time, effort, and a step by-step approach. It is likely that AI may first be utilized to address simple problems before handling more complex or specific issues. Despite these barriers, organizations must embrace AI as a way to improve claims processing outcomes and to reduce operational costs. It is also important to up-skill existing staff on AI concepts and technologies to promote a culture of innovation and to ensure the successful implementation of AI in healthcare claims processing [10]. These AI technologies can be incorporated into a healthcare organization's existing system through its software development kit or through building a custom tool by utilizing pre-existing models. Despite these options, some barriers may hinder the rapid adoption and implementation of AI in healthcare claims processing. Firstly, expertise and knowledge in both AI and domain-specific healthcare business standards are required to

either customize an AI model or to build a new model from scratch. Secondly, high quality, specialized and labelled data for model training and testing are essential. Data may come from internal or external sources and must be integrated with existing health IT infrastructure and systems. Thirdly, it may be challenging to integrate an AI solution into existing healthcare business processes and systems [11].
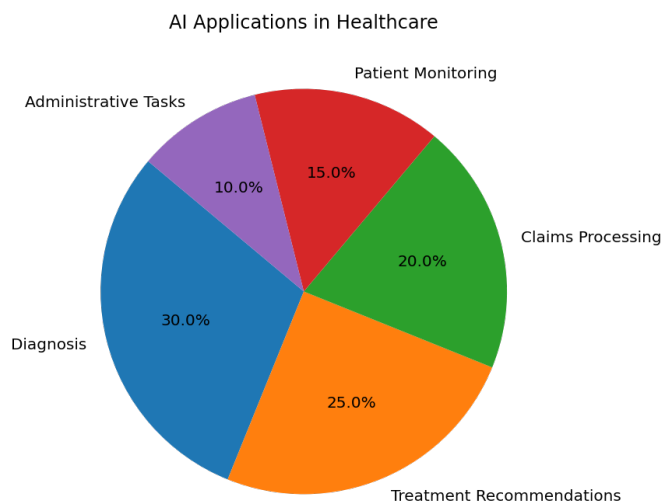

Fig. 2: AI Applications in Healthcare

Artificial intelligence (AI) is finding its way in all the nooks and crannies of healthcare. But what's happening with healthcare administration use-cases such as claims processing? McKinsey, in their report on the potential of AI in healthcare, found that healthcare administration areas such as revenue cycle management, healthcare operations with administrative complexity, and support functions stand to gain the most cost savings derived from applying artificial intelligence. So why is it that not a lot of AI is being utilized in these critical areas? In fact, it turns out that only 4% of vendors with AI solutions are focusing on these healthcare administration areas, with the rest of the AI applications in healthcare being focused on personalized health and R&D [10,11]. The goal of the paper, then, is to review and recommend Artificial Intelligence methods with validation to other greats about optimizing wisdom for enhanced excellence in healthcare claims processing automation and fraud prevention. The healthcare industry has started leaning towards artificial intelligence to manage and maintain great levels of relevant business tasks and challenges. From profound learning to chatbots, AI is altering the way we work. In fact, in a recent study, it's been estimated that the healthcare AI market will exceed $34 billion by 2025 [11]. Yet, to benefit from this, healthcare payers and providers need to be on board and willing to embrace this new technology. It's no secret then that healthcare claims processing, and healthcare payment integrity, in particular, still involve a large number of manual interventions despite multiple solutions having been implemented to automate and optimize these processes. Artificial intelligence has the potential to revolutionize the way healthcare organizations operate, bringing cost savings, efficiency, and improved patient care. However, the adoption of AI in healthcare comes with its own set of challenges, including data privacy concerns and ethical considerations. Despite these challenges, the future of healthcare undoubtedly involves the integration of artificial intelligence into various aspects of the industry [11].

C. Traditional Approaches to Claim Validation and Fraud Detection

The critical step in the claims processing is the validation of a submitted claim with respect to many criteria which may be specific to the type of policy, type of claim, or the state in which the loss occurred. Traditionally, most of the validation is performed by claim examiners. The level of automation is relatively low and is limited to applying a small number of business rules within a workflow system [12]. Some businesses have an IT department creating and maintaining in-house functionality to check and validate claims. Third-party vendors provide software which is configured to match specific insurer's business rules as part of their Business Processing Offering (BPO). High-end Special Investigation Unit (SIU) vendors provide tools and services that help in fraud detection. Recent advances in AI technologies, such as the marriage of rules and machine learning, could provide scalable solutions that could be developed within claims departments as well.
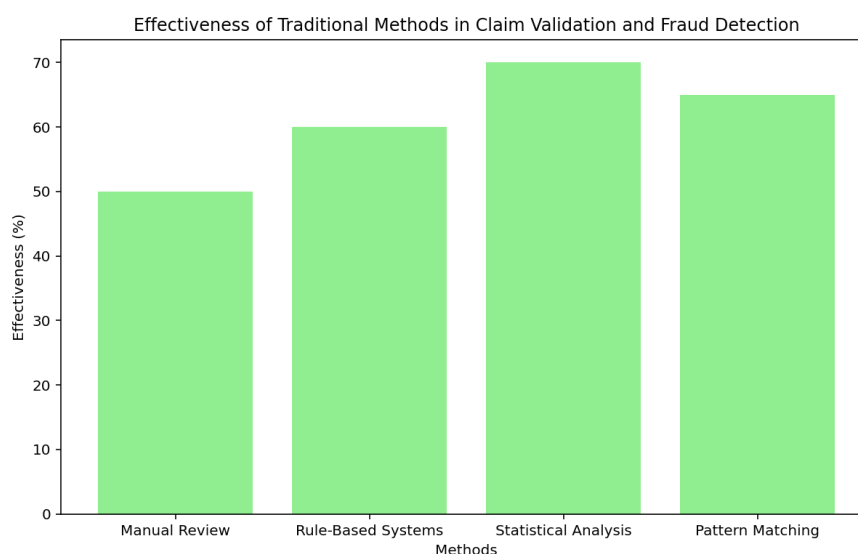

Fig. 3: Effectiveness of Traditional Methods in Claim Validation and Fraud Detection

While the focus in this chapter is in healthcare insurance claim processing, many of the solutions have a broad applicability to other insurance sectors. The commercial and high-end SIU specific solutions are relatively generic due to the nature of underlying regulations. Hence, the commodities of scale and scope generate products acknowledged by specific vendors. Intensification Establishment-created Quest for Intelligence. Information about medical claims is fragmented as it goes through the life cycle of processing within the department [13]. The SIU analysts may have to request information about a claim from the various departments within the company. Since requests are done manually, it may take a considerable amount of time to provide analysts with information to make an informed decision about the claim. This may lead to the analysis not being performed efficiently and the company incurring losses due to fraud if they are not found.

D. Role of Artificial Intelligence in Claims Processing

Artificial Intelligence Applications: The promise of AI is to alter healthcare's cost and quality trajectory. AI applications have a broad scope. Their aims include both clinical and administrative applications. In terms of administrative functions, AI can support healthcare claims processing. The operational back end of healthcare claims processing is largely shielded from public scrutiny, although it is the front office of healthcare financing. Commercial health plans spend 13-20% of premium revenues on claims processing. When scaled to national healthcare, these amounts to major components of

national healthcare expenditures. In financial terms, commercial insurance providers are processing millions of claims daily. The sheer volume of claims is a major source of inefficiency [13]. In addition, the lack of data quality has led to poor business rules and fragmented business processes, resulting in more manual intervention. Since the healthcare back office is a rule-based area with specialized knowledge and automated systems, the applications for AI in back-office processing are specialized, knowledge-based systems. As claims processing is labor intensive, it is fertile ground for applying AI technology to obviate labor costs. Challenges with AI Applications: Although artificial intelligence (AI) has the capability to match human reason, and several AI applications have been successfully implemented in the commercial sector, introducing AI technology in the operational back end of healthcare insurance remains a challenging task. This is due to a number of factors, including the quantity and quality of eligible training data, the complexity of business rules required to develop characteristic AI for explaining specialized task knowledge, the difficulty of the interpretability problem associated with knowledge-based AI, and the issue of gaining user trust, particularly for AI that purports to know the truth and can determine a person's benefits [14].
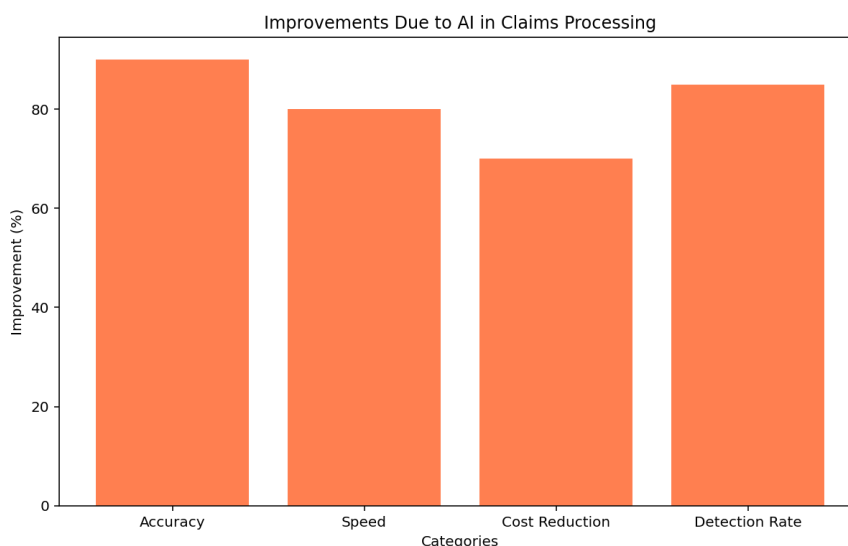

Fig. 4 Improvements Due to AI in Claims Processing

E. Techniques and Algorithms for Claim Validation

Claims validation is an important step in healthcare claims processing as it ensures that the claims are accurate and complete before significant claim adjudication begins in order to maintain a streamlined adjudication process, reduce claim denials, and provide higher accuracy in payments. For this to happen, a primary check is to be done on the claim once it is received in the system, after which the claim has to be routed to a particular workflow that validates a claim based on the information provided in the claim. In Figure 5, claim validation is a part of the flow from obtaining a claim form or claim through the claim processing system and then moving on to the settlement of a claim/payment execution loop. It is to be performed soon after the claim is received. Complexity or the diversity of healthcare claims and their processing exist at the fullest extent possible. It is the pharmaceutical or healthcare industry where business rules are the most enforced in the world [14,15]. Detailed, professional examinations and healthcare associated with the specific reimbursement for performed services lie at the core of the health claim processing. Claim validation is the process of verifying that a healthcare service meets, for the first time or through resubmission of a claim, the terms and conditions of a health insurance plan. Claim validation criteria must be met by automated, software-based claim processing. Otherwise, the overall

outcome of claim processing would likely not be acceptable for efficient processing of healthcare claims.

F. Techniques and Algorithms for Fraud Detection

Supervised Learning: Supervised learning requires a pre-labeled training dataset. Despite the availability of big data in healthcare, the labeled data needed for supervised learning methods is generally scarce due to the high cost of expert labeling. However, it is considered far more accurate than unsupervised learning in detecting healthcare fraud. To address the challenge, researchers typically use a mixed initiative labeling approach that combines expert knowledge with user feedback. They also utilize active learning that incrementally selects the most informative data instances for labelling [15,16]. In addition, researchers have used transfer learning techniques that leverage knowledge from related tasks with ample training data, such as claim validation. Finally, researchers train detectors for different types of fraud using distinct labeled datasets and then combine the detectors using ensemble learning. Unsupervised learning: Unsupervised learning is the most widely used approach to detect healthcare fraud [16,17]. It is considered very powerful as it does not require prior training examples of fraud. It only requires a representation of "normal" or "usual" behavior to detect outliers. Clustering is widely used and one of the most popular outlier detection methods. It groups similar data instances together and identifies dissimilar instances as outliers. Healthcare services such as procedures, diagnoses, and drugs are usually represented in vector spaces and clustering methods such as K-means and hierarchical clustering are utilized.

4. Contributions

My contribution in this study is to take an end-to-end perspective on healthcare claims processing and contribute automated claim validation and fraud detection systems. Existing automated claim review systems are limited to pre-admission eligibility checks, and post-treatment reviews based on electronic medical records. Third, very little AI is employed in healthcare claims review. Commercially available AIM systems are almost non-existent in this field. The research fills a serious gap as fraud and abuse in healthcare claims processing are significant and increasing, fraud only being surpassed by the IRS income tax fraud, and the US Department of Justice labeling healthcare fraud as a 'national criminal priority'. Furthermore, the research responds to the low level of up-to-date technology in healthcare claims processing. In very practical terms, we propose a framework for claim validation that ensures the decision-making process of settling accounts for services rendered is legal, accurate, and properly documented, taking into consideration the considerable value of a quick settlement to both parties of a healthcare claim, the risk of abuse, incompetence or fraud on the part of the provider, and the risk of inadequate or incorrect claims processing on the part of the payer. We then propose an enhanced framework for fraud detection, expanding the opportunities for detecting fraud, waste, and abuse, by creating a learning organization that can make use of knowledge discovery techniques, both from data and human inputs. This is achieved by combining expert systems and adaptive case-based reasoning systems, the organization capable of becoming a mature adaptive intelligent enterprise.

5. Significance and Benefits to the U.S.

Expert systems can play a vital role in healthcare claims processing, providing real-time responses for common interactions. In cases where further investigation is warranted, the utilization of expert systems can help collect and consolidate information necessary to make informed decisions. The providers of healthcare services will also benefit from quicker responses, as delays in adjudicating claims can

improperly withhold revenue from providers while increasing the chances of claim denials from the provider's side [18]. Claims processing is at the heart of the administrative functions of healthcare payers and providers. It is also one of the most labor-intensive, with activity in the processing area representing as much as 75 percent of operating costs. A typical medium-to-large size payer processes millions of claims per year, with each claim representing multiple interactions and handlings. Despite significant developments in claims processing technology - most notably the emergence of electronic data interchange (EDI), the deployment of sophisticated data management and decision support software, and the integration with enterprise resource planning (ERP) applications, claims processing remains expensive, error-prone, and time-consuming [19]. The natural language understanding capabilities of artificial intelligence technologies such as rule-based expert systems combined with statistical methods have the potential to drastically streamline the validation and fraud detection of healthcare claims processing, allowing more resources to be devoted to patient care.

6. Conclusion

This paper focussed on exploring AI systems role in automating significant functions within the healthcare claims processing. To begin, the agent system that we have meticulously developed has the capability to automate the validation process for both individual claims and the utilization of regular expressions, which are frequently employed to depict a substantial number of similar claims. These regular expressions have the capacity to encompass entire groups of claims that have been furnished by healthcare providers and are derived from the various services that are made available at healthcare facilities. Subsequently, the agent-based system that has been constructed also possesses the ability to engage in knowledge-intensive fraud detection by means of communicating and collaborating with numerous other diverse intelligent agents. This agent effectively communicates with claims data and an array of reasoning models, which includes models that have the capability to engage in both probabilistic and symbolic reasoning. Following the completion of our empirical study and a comprehensive discussion we engaged in with an expert in the field, it has become apparent that the agent possesses the capacity to significantly enhance the detection of fraudulent activities, particularly those that involve collusion. The extensive nature of this work enables it to be applicable to various other domains and tasks that involve the detection of fraudulent behavior. Healthcare claims serve as a complex, formal communication of services rendered by a healthcare provider to either an insurance company or the covered individual. The insurance company reviews the claims for accuracy and completeness before reimbursing the provider according to the services covered by the patient's insurance plan. Healthcare claims processing encompasses all of the steps taken by the insurance company from receiving a claim to reimbursing the provider. This process involves many different functions, most of which are currently performed by a large number of people. Although the functions are people intensive, most of the knowledge required to perform the tasks is not knowledge intensive. Consequently, it becomes possible to design AI systems that apply rule-based technologies to drastically minimize the hours needed to accomplish the tasks. The task of processing the claims of health care is an essential part of healthcare; it is a method of keeping records and reimbursing people for the services they give to the health care system. This procedure implies the processing of a significant number of claims, while each of them should be considered and checked for the presence of mistakes. Due to the high number and versatile nature of the claims, the manual handling of the claims can hence be both time-consuming and accurate. It is in this regard that AI systems provide a solution having handling many of the routine and procedural activities that are characteristic of claims processing. The healthcare industry harnessing AI technologies

can help in streamlining the claims processing of work, minimize chances of errors and in the process, help accelerate the process of reimbursement for healthcare providers.

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