HealthManagement.org
The Journal
LEADERSHIP • CROSS-COLLABORATION • WINNING PRACTICES
VOLUME 19 • ISSUE 1 • 2019 • € 22
ISSN = 1377-7629

UnBLOCK the Chain

Blockchain for radiology

Key areas where Blockchain has the potential to spark a revolution & increase quality while decreasing healthcare cost.

Blockchain is an exciting new technology that promises to address many problems that exist within the current framework in radiology. We discuss three key areas where Blockchain can potentially spark a revolution and increase quality while decreasing healthcare cost.

Bhargav Raman
Radiologist, Chief Innovation Officer
Medpixels Inc.
San Francisco Bay Area, USA

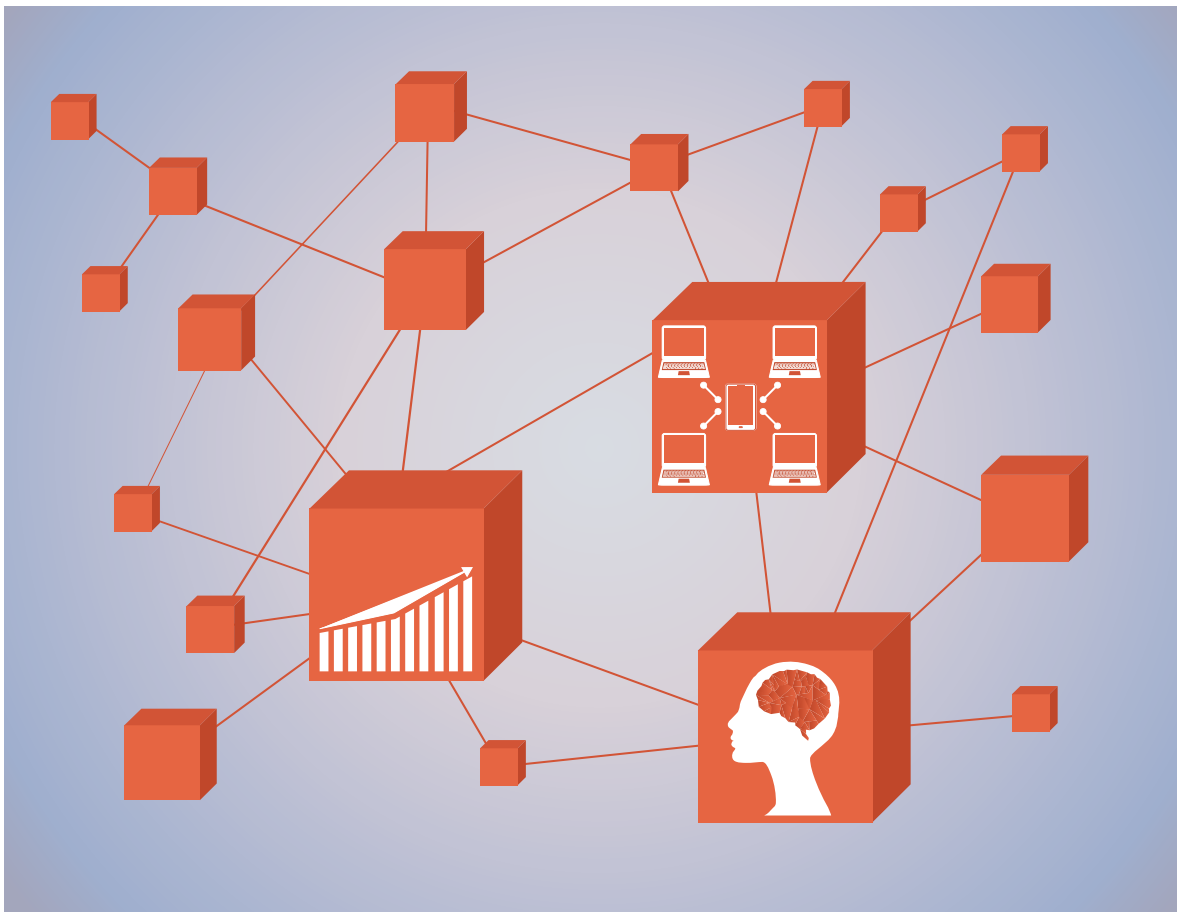
ramanb@medpixels.com

linkedin.com/in/bhargavraman

Krithika Chandrasekaran
Radiologist, COO
Medpixels Inc.
San Francisco Bay Area, USA

kc@medpixels.com

linkedin.com/in/krithika-chandrasekaran-md-mph-candidate-1164b6144/



Blockchain technology is an exciting new technology that promises to address many problems that exist within the current framework in radiology. The radiology economic model is ripe for disruption with the possibility to eliminate profit-focused intermediaries to better connect the referring clinician and radiologist. Data sharing between radiologists and their referring clinicians is key to improving the quality of radiology reports – radiologists cannot read blind. Finally, the rise of AI is imminent and has brought the need for massive amounts of good data for training. Blockchain can help create the needed datasets and support the continuous evaluation and improvement process needed by AI.

Economics

The practice of radiology is in crisis. Rampant commoditisation of radiology has resulted in a race

to the bottom in terms of quality in the name of decreasing cost and decreasing turnaround times for busy, Diagnosis Related Group (DRG) capitated emergency rooms and hospitals. The entire economy is based on cranking through as many patients as possible in as little time as possible. The practice of radiology and indeed healthcare in general has become a factory, a factory in which both doctors and patients are exploited for monetary gain by private equity and large consolidated hospital systems.

> "THE PRACTICE OF RADIOLOGY HAS BECOME A FACTORY IN WHICH BOTH DOCTORS AND PATIENTS ARE EXPLOITED FOR MONETARY GAIN"

The question of quality also looms large in today's high-volume environments. One could put in normal radiology reports without looking, but that is unacceptable. But how little looking is really 'not looking'? During training, we are taught to always use an unchanging mental system, such that we do not miss anything on any scan. In practice, radiologists still often miss, misinterpret or fail to mention findings, most of no clinical consequence, some with significant consequences. This is not because of a lack of a system or that the radiologists in question are incompetent, it is because radiologists look too fast, and in the worst case, are financially incentivised to look too fast.

Additionally, one could just describe imaging findings without giving a differential or helping the clinician interpret these findings in any way. This approach treats radiology as akin to laboratory test, which it plainly is not. Radiologists make critical decisions on every scan outside of simply reporting findings. Carefully constructed language in the report reflects our confidence in our findings and their clinical significance. Yet, again due to lack of time and sometimes due to sheer burnout from volume, radiologists will often just describe the findings, give a pro-forma differential, and offer no customisation to patient's unique presentation or symptomatology. Unstructured, often unreadable reports pervade this space, where the referring clinician often just reads the impression without really understanding the details. Legally speaking, this is fine, but the unhelpful radiology report that ends with 'clinically correlate' is a running joke in the clinical community.

Finally, there is the erosion of the doctor-doctor relationship between the radiologist and the referring clinician. These conversations often lead to major changes in the report or lead to major clarifications that directly affect patient care. However, the radiologist increasingly has little incentive to engage in these conversations and has less time to actually have a fruitful conversation. Time spent talking is time spent not reading another scan, and more time spent at the office finishing work.

Ultimately these issues are caused by profit-focused intermediaries whose incentive is to create the situation where every clinician is working as hard as possible to increase RVU and billing. Quality is an afterthought or a regulatory necessity. The business of radiology is ripe for decentralisation, as the diagnostic radiologist can work from any location and indeed could be in any part of the world. With the right structure, a blockchain-based decentralised teleradiology system would completely disrupt the industry by eliminating adverse incentives and creating healthy competition between radiologists to provide timely, quality reads, and competition between clients to pay for these reads.

Imagine a system whereby any client, whether it be a large hospital system or small imaging centre, does not need to negotiate pricing with any vendor. Instead, the client need only use open-sourced software and standards to connect to a decentralised Blockchain-based system that gives them direct access to individual radiologists, each of whom have set pricing for their reads, credentialing information, speed and quality metrics. Other software built on top of the system can automatically send studies to particular radiologists based on this public data. Reporting times, referring physician feedback and quality scores can be immutably stored on the Blockchain. Clients who need faster reads would need to pay more to compete for radiologist attention. Similarly, radiologists who are faster, have a sub specialisation or have higher quality can potentially charge more for their services. This kind of competition leads to a healthy ecosystem where incentives are aligned towards better value and optimisation along the quality, cost and timeliness dimensions. Versions of such a system have also been proposed or have reached partial implementation and are also worth a read (Patel 2018); (Reinsmith 2017); (MDW

n.d.). There are several issues that need to be solved before such a system can become a reality. First, most large hospital systems have draconian credentialing requirements that include submission of paper documentation of licensing and other information in order to be credentialed at a hospital to provide services. Private imaging centres are more agile in this respect and may be the first target customers. In addition, in the United States, medical licensing requirements differ from state-to-state and maintaining a 50-state license is close to impossible for a single person. These functions would also need to be decentralised and outsourced in order for the system to function. Privacy is another major issue, though solvable. For example, it is a given that each client already has their own storage. The Blockchain could simply store an encrypted access link with unique keys provided only to the radiologist to whom the case has been assigned. No patient information need actually be stored on-chain. Indeed, storing vast amounts of information on-chain is not efficient as the chain size can exponentially increase causing increased computational resource needs to run the Blockchain.

While simple in concept, the implementation can become highly complex as anyone who has run a teleradiology company can attest. However, these kinds of solutions are needed on the road to decentralise healthcare economics, align incentives and ultimately drive value optimisation.

Data sharing and quality

When we talk about health data siloes, one must acknowledge the elephant in the room: medical imaging. Radiology is not only siloed with respect to the data availability and data sharing but the radiologists themselves are often cut off from the patients for whom they are reading a scan. Due to lack of actual interaction with the patient the radiologist often has to deal with vague symptom descriptions such as "pain," which is often entered more for the purposes of successful billing than for actual accuracy. The quality of communication in radiology requisitions is in alarming decline (Wassermann & Straus 2018). Without an appropriate background the quality of the read suffers and ultimately results in poor patient outcomes. Often, the common advice is: why not call the ordering physician? Unfortunately, while this seems like the obvious solution the main problem is time. As already mentioned, radiologists are extremely time-limited, but so are the referring clinicians, due to the same factory mentality.

While there have been trends towards value-based practice for healthcare in general there seems to be little movement for incorporating this for medical imaging. Programmes such as Merit Based Incentive Payments System (MIPS) have taken first steps but do not address the important issue that the radiologist is essentially blinded to the patient history and treated like a lab technician rather than a doctor. The radiologist needs to be patient-centric not image-centric. But this can only be done through effective and easy data sharing between institutions.

Much has been discussed regarding Blockchain-based EMRs and there is already great momentum around storing and accessing EMRs on the Blockchain (Dubovitskaya et al. 2018). Coupled with algorithms designed to show relevant data to the remote radiologist, the radiologist would have enough data to connect the dots in order to provide a better quality read. In addition, if any follow-up recommendations are given, these recommendations can also be stored and validated on the Blockchain.

> "CHANGES CAN BE ACCELERATED WITH BLOCKCHAIN TECHNOLOGY WITHOUT THE NEED FOR EXPENSIVE, PROFIT-FOCUSED INTERMEDIARIES AND ADMINISTRATIVE STRUCTURES"

Additionally, through implementing smart-contract based value-based models and payment systems, we can not only create novel quality metrics, one can also directly incentivise the improvement of these metrics in a trustless, decentralised manner that reduces burdensome administrative cost and complexity that generally come with value-based payment programs. For example, quality metrics could include referring provider and patient satisfaction, compliance with MIPS criteria, structured reports, extent of report editing, number of correctly protocolled exams, appropriate follow up in concert with ACR guidelines, among others (Heller 2016). Blockchain can do all this in complete transparency without the added administrative costs burdening implementations today.

The rise of artificial intelligence (AI)

Whether we like it or not, AI is coming. The extent of its impact on the practice of radiology and radiology training is yet to be seen. That said, if one looks at mammography (arguably the simplest of the modalities to write and train an algorithm or AI for), it has already undergone a fundamental change due to the introduction of computer aided detection of anomalies on breast mammograms. Radiologists most often use the system as a second reader and evaluate every one of the false positives detected by such systems for the elusive true positive, but the impact on sensitivity for suspicious lesions is significant. Most likely, as AI interpretation of images becomes more and more common, the combined human and machine approach will be the wave of the future throughout radiology. Radiology will eventually morph into not only how to interpret images but how to use the various AI systems for maximum value.

The problem here is dependable data that is distributed, secure, available and constantly updated. To train the best deep learning networks, one needs as much good data as possible. Otherwise, often rare events will not be reliably detected without extensive feature engineering and the influence of selection bias will affect the generalisability of the final product. Because we often lack insight into deep learning models, biases can be insidious and become dangerous. Unlike mammograms, the number of possible pathologies increases exponentially on other modalities, increasing multifold the computational complexity, and therefore the needed data and training time. After initial training, the next major step is a continual improvement process where the AI constantly evolves using real-world data. This is where decentralised, trustless data sharing can have a major impact. A Blockchain-based AI can not only learn from shared data from multiple institutions, designers can track and evaluate its learning by looking back or simply replaying the chain, giving more insight and greater human oversight on AI decision making. True and false positives and true and false negatives as determined by users and validated on the Blockchain by other radiologists on the network can eventually create the kind of large dataset needed to train complex systems.

Conclusion

Provision of healthcare in the United States and elsewhere will undergo a fundamental change in the next 20 years as the current downward spiral of value changes. Market solutions that align incentives to provide that value will ultimately lead to optimisation along the quality, cost and timeliness dimensions. In addition to fundamental economic changes, the shift to value-based incentivisation will require creation of novel models. Finally, AI is bursting onto the scene and the need for massive amounts of good data will drive efficient, decentralised methods of data sharing and training dataset creation. All of these changes can be accelerated with Blockchain technology without the need for expensive, profit-focused intermediaries and administrative structures. ■

KEY POINTS

- ✓ Economics - Key economic factors in the practice of radiology render it ripe for decentralisation
- ✓ Data Sharing – Data sharing between radiologists and their referring clinicians can be enabled by blockchain technology
- ✓ AI – The rise of AI has brought the need for massive amounts of good data for training. Blockchain can help.

REFERENCES

Dubovitskaya A, Xu Z, Ryu S, Schumacher M, Wang F (2018) Secure and Trustable Electronic Medical Records Sharing using Blockchain. AMIA Annual Symposium Proceedings, 2017, 650–59.

Heller RE (2016) An Analysis of Quality Measures in Diagnostic Radiology with Suggestions for Future Advancement. Journal of the American College of Radiology, 13:(10), 1182–87.

MDW (n.d.). Available from mdw.io/

Patel V (2018) A framework for secure and decentralized sharing of medical imaging data via blockchain consensus. Health Informatics Journal.

Reinsmith L (2017) A Blockchain for Medical Imaging. Available from from medium.com/@semanticmd/a-blockchain-for-medical-imaging-b0bacb356374

Wassermann TB & Straus CM (2018) A Failure to Communicate?: Trends in the Radiology Requisition, 2011–2016. Academic Radiology, 25:(7) 943–50. doi.org/10.1016/j.acra.2017.11.029