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Review Article

Cryptocurrency as Payment in Orthopedic Surgery

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Orthopedic surgery has always been at the leading edge of innovation in medicine, from clinical applications to business practices. Cryptocurrencies have emerged as an exciting new technology where transactions and verification are secured by cryptography rather than a centralized authority, thus creating transparency, security, and immutability to payments. Large industries, including healthcare, have started accepting cryptocurrencies as alternative forms of payment. Insurance companies and private practices in specialties such as plastic surgery and dermatology already accept cryptocurrencies in exchange for services. As such, providers in orthopedic surgery should prepare themselves for inquiries from patients regarding cryptocurrencies. This paper introduces the topic and potential benefits to future orthopedic practices.

Cryptocurrencies and blockchain technologies have garnered significant attention in the media, however the space is still in relative infancy. Blockchains can be thought of as ledgers that exist on a network of computers where "blocks" of data or transactions are recorded. By creating a decentralized system, blockchains have enhanced security

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doing to further patient care.

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because the integrity of the distributed ledger is continuously verified by multiple nodes rather than one central authority, and the network is secured with cryptography. Once a block is verified by the network and added to the chain, it exists in perpetuity. Security, immutability, and transparency are some features and benefits of blockchains. The maintenance of these ledgers is incentivized by the issuance of "tokens'' for validation of new blocks on the chain. Tokens are representations of digital assets or utilities on blockchains, and cryptocurrencies refer to a specific subset that are often rewarded for maintaining the fidelity of blockchains. For example, in a proof-of-work consensus mechanism like Bitcoin, miners are rewarded with a token in the form of Bitcoin after solving a complex math problem that is required to validate a new block and the history of the chain. Other notable digital assets on blockchains aside from cryptocurrencies are non-fungible tokens, or NFTs, which are tokenizations of unique assets as opposed to mutually interchangeable assets such as cryptocurrencies. NFTs can exist virtually like digital art or as representations of real-world assets, such as real estate deeds or tickets to events. The applications of digital assets show promise in simplifying complex systems like finance but are still nascent with novel uses that are yet to be discovered.

Cryptocurrencies are a rapidly evolving form of money, providing a medium of exchange, store of value, and unit of account. Many cryptocurrencies exist with varying characteristics and capabilities, but it is helpful to introduce the concept with Bitcoin. The first widely adopted cryptocurrency with the largest market share, Bitcoin, was introduced in a whitepaper by Satoshi Nakamoto in 2008 and was developed to establish trust between two entities to transfer value over the internet. The paper described the financial institutions of the world as inefficient as they mostly required third parties, such as banks or governments, to facilitate transactions. As such, traditional payment systems can be slow and incur significant cost, particularly for exchange between countries. As an alternative to traditional payment methods, Satoshi proposed a digital currency on a peer-to-peer network using cryptography instead of trust in a third party. This would allow online payments directly between two parties without an intermediary to facilitate the transaction, thus avoiding any associated fees or processing time. These types of transactions would also be resistant to reversal and could protect both sellers and buyers from fraud (Plescia, n.d.; Nakamoto 2008). This system provides consumers with full authority and ownership of their money without relying on a custodian, while still maintaining security and fidelity on the blockchain. Additionally, some cryptocurrencies, such as Bitcoin, have a predetermined supply to prevent manipulation and theoretically limit inflation (Nakamoto 2008). These characteristics have made Bitcoin an attractive alternative, particularly in countries without stable currencies.

While initially thought to be used solely for illicit activities due to the direct, anonymous exchange between parties, cryptocurrencies have gained considerable traction and acceptability even by large corporations (Tuwiner 2021). Ownership of digital assets on the individual level has been increasing at an exponential rate, so its use as payment by consumers may follow a similar trajectory. A survey performed by one of the largest crypto exchanges estimates that 21.2 million American adults own cryptocurrency, most of whom are 25-44 years of age (Gemini, n.d.). Cryptocurrencies can be mined by verifying transactions on a blockchain, through mechanisms such as proof-of-work as described above. They may also be obtained through cryptocurrency exchanges, such as Coinbase, Binance, or Kraken, which facilitate trading of fiat and cryptocurrencies for pre-determined fees. Additionally, exchanges and other online payment processing services, such as PayPal, provide infrastructure for businesses to accept cryptocurrencies as payment. Exchanges have simplified the acquisition and utilization of cryptocurrencies for most users and will continue to drive growth.

Orthopedic surgery continues to be at the forefront of innovation in medicine, especially the adaptation and implementation of new technologies related to clinical care and novel business practices. Further, given the complexity of the financial arena in healthcare, it is paramount that physicians be up to date on the evolving reimbursement structures and new payment methods. Many clinical services are not covered by insurance policies and are thus paid for out-of-pocket. Examples in medicine in general in-

clude concierge medical care, cosmetic procedures, in vitro fertilization, and experimental treatments such as novel cancer therapies. As such, it is reasonable to assume that patients will start inquiring about cryptocurrency as payment for services that are paid as out-of-pocket costs. Digital currencies are already being used for payments in certain clinical settings. Private aesthetic practices in plastic surgery and dermatology, which routinely accept cash payments for procedures and consultations, have been the earlier adopters of this new technology (MPS Group 2020; Silk Clinic, LLC, n.d.; Matlin 2021; Loftus Plastic Surgery Center, n.d.; Wiener and Boyd 2022). Insurance companies have also begun accepting Bitcoin for premiums after discovering many customers were inquiring about alternative payment solutions in the form of cryptocurrencies (Adejumo 2021). Finally, hospital systems are slowly adopting cryptocurrency. Institutions such as Mayo Clinic, Nicklaus Children's Hospital, and Cape Cod Healthcare, have begun accepting donations in the form of Bitcoin (Plescia, n.d.). This may represent the first step to eventual acceptance of cryptocurrency as payment for healthcare services.

Cryptocurrency has several benefits that make it an attractive alternative to traditionally accepted payment methods, and as adoption of cryptocurrency continues to rise globally, its usage in healthcare may likely increase. With cryptocurrencies the interoperability of an open network can effectively eliminate financial intermediaries, potentially reducing the friction of payments. Cryptocurrency can also offer a more secure form of payment. Some transactions could be scrutinized by third parties and should be kept private to protect patients. Privacy for sensitive transactions is enhanced as these transactions are directly between patient and providers. Orthopedic surgeons should prepare for alternative payments in the form of cryptocurrencies as consumers continue to embrace their use. In orthopedic surgery specifically, out-of-pocket payments are routinely seen in outpatient surgeries and minor clinic procedures, such as therapeutic injections. Additionally, some surgeons pivot to cash-only practices for major procedures such as hip and knee arthroplasty and spinal fusions. Practices have already begun accepting digital currency in exchange for their services (Crawford, n.d.). Early acceptance of cryptocurrencies could serve as a marketing strategy and afford a competitive advantage over peers, especially given the daily media attention given to the multi-trillion-dollar crypto market. For patients, cryptocurrencies offer a secure and transparent method of payment for therapeutics with elimination of third parties. Orthopedic surgeons should familiarize themselves as patient inquiries regarding digital currencies will likely continue to grow.

Cryptocurrencies are still a relatively new technology with significant risks. First and foremost, cryptocurrencies are volatile and are often viewed as speculative assets which impairs their ability to be used as mediums of exchange. Given their volatility, some healthcare institutions may hesitate to accept a payment method with a highly variable value relative to the US dollar because it could depreciate. Additionally, there are tax implications when buying and selling digital assets. Based on current IRS code, they are deemed "property" and are subject to capital gains taxes when sold. As such, capital losses can also be reported to decrease taxable income and thus overall tax burden ("IRS Notice 2014-21," n.d.). There are also other concerns with cryptocurrencies that extend beyond financial characteristics. One significant criticism, particularly with Bitcoin, relates to energy consumption and environmental impact because substantial computing power is required to maintain the blockchain. Some pundits argue that this is a feature that allows for energy to be "stored" as value in the form of cryptocurrency. Nonetheless, these concerns have led to the development of blockchain technologies with smaller carbon footprints, such as proof-of-stake in Ethereum 2.0, while maintaining many benefits. Much of the focus has been on Bitcoin because of its prominence in the space, but there are a multiple of other cryptocurren-

cies with unique capabilities that could emerge as superior alternatives for specific applications.

The cryptocurrency market is dynamic and burgeoning, as evident by the extreme volatility of asset pricing. As such, its use as a currency is limited. However, acceptance and mainstream recognition continues to grow rapidly, especially in international markets. For example, El Salvador recently legislated Bitcoin as an official legal tender. As major industries continue to embrace cryptocurrency, the field of orthopedic surgery should seize the opportunity to be an early adopter of cryptocurrency in healthcare. Providers and administrators should educate themselves on this technology as its utilization expands to provide avenues for business growth and greater patient access to therapeutics by accepting digital assets.

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