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Examine the Potential of AI and ML Technologies to Simplify and Enhance Compliance with GxP Regulations in Life Sciences

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The growing complexity of GxP (Good x Practice) compliance in the life sciences market requires sophisticated technology solutions to assure regulatory compliance, data integrity, and process optimization. Artificial intelligence (AI) and machine learning (ML) are becoming revolutionizing technologies to automate compliance tracking, validation, risk analysis, and regulatory reporting. This paper discusses how AI/ML can be exploited in pharmaceutical manufacturing, clinical trials, and regulation submission, enumerating their utilization in predictive analysis, anomaly discovery, and self-documentation. AI increases accuracy of compliance as well as improves operations but in adoption, the following challenges emanate: regulation, ethics, and technology through explainability, bias, as well as securing data. The research also touches upon changing regulatory viewpoints, the necessity of harmonized AI-based compliance frameworks, and future directions for research to make AI integration in life sciences regulations seamless. As AI continues to be increasingly adopted, industry and regulators have to come together to define open, consistent, and globally recognized AI validation practices that will underpin the compliance future of life sciences.