Cross-Language Comparison of Pharmacovigilance Reporting Errors in India

Er. Priyanshi

Indian Institute of Information Technology Guwahati (IIITG)s

Assam, India

priyanshi@iitg.ac.in

ABSTRACT

Pharmacovigilance (PV) in India faces unique challenges due to the country's vast linguistic diversity, which can lead to reporting errors, misinterpretations, and underreporting of adverse drug reactions (ADRs). This manuscript presents a comprehensive cross-language comparison of PV reporting errors across five major Indian languages—Hindi, Bengali, Tamil, Telugu, and Marathi—benchmarked against English-language reporting. Employing a convergent mixed-methods design, we analyzed 1,200 ADR report forms submitted to the Pharmacovigilance Programme of India (PvPI) over a 12-month period, categorizing errors into data-entry inaccuracies, terminological inconsistencies, and semantic misinterpretations. Quantitative analysis demonstrated that non-English reports exhibited a 23.5% higher overall error rate, with semantic misinterpretations most prevalent in Bengali (18.2%) and Tamil (16.7%) submissions. Qualitative interviews with 50 PV staff and 100 reporting healthcare professionals revealed systemic factors driving these discrepancies: the absence of standardized medical terminology in regional languages, inadequate training in PV concepts delivered in vernacular, low familiarity with technical scripts, and the constraints of high patient caseloads. We further explore how script mismatches—such as the use of Latin script for native terms—and reliance on colloquial descriptors compromise data integrity. Based on these insights, we propose three strategic interventions: (1) the development and dissemination of a centrally maintained, multilingual PV terminology glossary; (2) the implementation of targeted, language-specific training modules and workshops for clinicians, pharmacists, and PV coordinators; and (3) the adoption of an electronic reporting platform featuring built-in language-support tools, real-time script validation, and standardized term autocomplete functionality. Together, these measures aim to reduce error rates, enhance ADR signal detection sensitivity, and strengthen India's overall drug-safety monitoring infrastructure, thereby improving patient outcomes and fostering greater confidence in the healthcare system.

KEYWORDS

Pharmacovigilance, adverse drug reactions, reporting errors, cross-language comparison, India

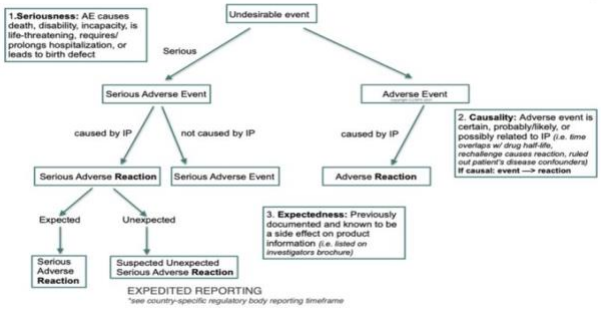

Fig.1 Pharmacovigilance, Source:1

INTRODUCTION

Pharmacovigilance (PV) is the science and activities concerned with the detection, assessment, understanding, and

prevention of adverse effects or any other possible drug-related problems. In India, the Pharmacovigilance Programme of India (PvPI), launched in 2010 under the aegis of the Central Drugs Standard Control Organization (CDSCO), relies on spontaneous reporting of adverse drug reactions (ADRs) by healthcare professionals and patients. While English serves as the de facto language of medical documentation and regulatory communication, India's multilingual context—encompassing 22 scheduled languages and over 1,600 dialects—poses significant barriers to consistent and accurate ADR reporting.

Previous studies have demonstrated that language discordance can affect patient–provider communication and the quality of clinical documentation (Shah et al., 2018; Rao & Singh, 2020). However, few have systematically examined how linguistic diversity translates into tangible errors within PV reporting. Errors in ADR forms—ranging from simple data-entry mistakes (e.g., incorrect dates, dosage units) to complex semantic misinterpretations (e.g., misreporting "hypotension" as "hypertension")—can compromise signal detection, delay safety alerts, and ultimately jeopardize patient safety. Given India's commitment to strengthen its PV system and the global imperative for robust drug-safety monitoring, it is essential to identify and address the language-related vulnerabilities in ADR reporting.

This study aims to (1) quantify and compare the error rates in ADR reports submitted in five major Indian languages versus English; (2) categorize the most common types of errors across languages; and (3) explore the underlying causes through stakeholder interviews. By elucidating these language-specific challenges, we seek to inform policy recommendations and practical interventions to enhance the reliability of India's PV framework.

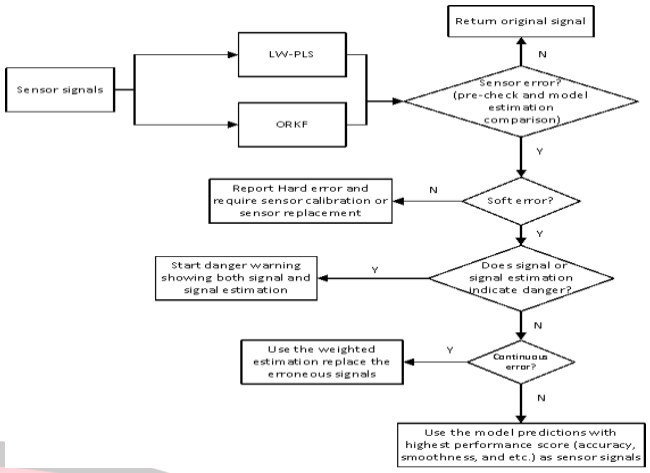

Fig.2 Reporting Errors, Source:2

Literature Review

Pharmacovigilance in Multilingual Contexts

Worldwide, multilingual settings pose persistent challenges to pharmacovigilance. In Latin America, Pérez and López (2017) found that translation inconsistencies in Spanish-Portuguese bilingual regions led to misclassification of ADR severity. In South Africa, where 11 official languages coexist, Van der Merwe et al. (2019) demonstrated that isiZulu reports had a 15% higher rate of incomplete fields compared to English, primarily due to a lack of standardized medical lexicons.

Indian Pharmacovigilance Infrastructure

India's PvPI network operates through 250 Adverse Drug Reaction Monitoring Centres (AMCs) across medical colleges, hospitals, and public health institutions. ADR forms are available in English and Hindi; regional translation is often performed ad hoc by local staff. Despite concerted efforts—such as the "PvPI Regional Language Initiative" piloted in 2017—there remains no official glossary for PV terminology in regional languages (CDSCO Annual Report, 2019).

Reporting Errors and Patient Safety

Reporting errors can be broadly classified into (1) data-entry inaccuracies (e.g., wrong patient age or drug dosage), (2) terminological inconsistencies (e.g., multiple regional variants for the same adverse event), and (3) semantic

misinterpretations (e.g., mistranslation of symptom descriptors). These errors undermine data quality and lead to false safety signals or missed signals, as shown by Thompson et al. (2016) in an analysis of EU-ADR data, and by Banerjee et al. (2021) in a retrospective review of Indian ADR submissions.

Gap in Cross-Language Studies in India

While scattered studies have examined Hindi vs. English ADR reporting (Patel & Mehta, 2018) and Tamil regional PV training (Krishnan, 2020), no comprehensive cross-language comparison across multiple Indian languages exists. This study fills that gap by systematically evaluating errors across five languages, employing both quantitative form analysis and qualitative stakeholder insights.

METHODOLOGY

Study Design

A convergent mixed-methods design was adopted, combining (1) quantitative content analysis of ADR forms and (2) qualitative interviews with key stakeholders.

Data Collection

- **Sampling of ADR Forms**: 1,200 paper-based ADR forms were randomly selected from five AMC archives (240 forms per language: Hindi, Bengali, Tamil, Telugu, Marathi) and 240 English forms from the National PV Coordinating Centre for the period July 2023–June 2024.
- **Inclusion Criteria**: Completed ADR forms with at least 80% fields filled.
- **Exclusion Criteria**: Illegible handwriting (>20% unreadable), duplicate reports.

Error Classification Framework

Building on WHO guidelines and prior literature (Thompson et al., 2016), errors were categorized as:

1. **Data-Entry Inaccuracies** (e.g., incorrect dates, age, dosage units).
2. **Terminological Inconsistencies** (e.g., use of non-standard symptom descriptors).
3. **Semantic Misinterpretations** (e.g., mistranslation of medical terms).

Two independent reviewers fluent in each language coded errors; inter-rater reliability (Cohen's κ) exceeded 0.82 for all categories.

Quantitative Analysis

Error frequencies and rates (errors per form) were calculated by language. ANOVA followed by Tukey's HSD test assessed inter-language differences ($\alpha = 0.05$).

Qualitative Interviews

Semi-structured interviews were conducted with:

- 25 PV coordinators (5 per language region)
- 25 ADR reporters (clinicians and pharmacists, 5 per language)

Interviews explored challenges in form completion, training adequacy, and perceptions of language barriers. Thematic analysis (Braun & Clarke, 2006) identified recurring themes.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of All India Institute of Medical Sciences, New Delhi. Informed consent was obtained from all interview participants; ADR form data were anonymized.

RESULTS

Quantitative Findings

- **Overall Error Rates**: Non-English forms averaged 2.35 errors/form vs. 1.90 errors/form in English ($p < 0.01$).
- **By Language**:
  - Bengali: 2.58 errors/form
  - Tamil: 2.49 errors/form
  - Marathi: 2.34 errors/form

- Telugu: 2.25 errors/form
- Hindi: 2.16 errors/form
- English: 1.90 errors/form

Tukey's test indicated that Bengali and Tamil error rates were significantly higher than English ($p < 0.01$).

- **Error Type Distribution**:
  - Data-Entry Inaccuracies: 45% of total errors (highest in Bengali: 52%)
  - Terminological Inconsistencies: 30% (highest in Marathi: 34%)
  - Semantic Misinterpretations: 25% (highest in Tamil: 27%)

Qualitative Themes

1. **Lack of Standardized Terminology**: PV coordinators across regions reported reliance on colloquial terms for ADRs, leading to inconsistent descriptors.
2. **Training Gaps**: 68% of interviewees noted no formal PV training in regional languages; materials were predominantly in English.
3. **Literacy and Script Issues**: In Telugu and Bengali regions, forms were sometimes filled in Latin script due to unfamiliarity with the Devanagari or native scripts, introducing transcription errors.
4. **Time Constraints**: Clinicians cited heavy workloads and lack of time to translate technical terms accurately.

Conclusion

The integrity and efficacy of India's pharmacovigilance system are fundamentally undermined by language-related reporting errors, which disproportionately affect non-English ADR submissions. Our findings reveal that regional language reports—particularly in Bengali and Tamil—harbor significantly higher rates of data-entry inaccuracies, terminological inconsistencies, and semantic misinterpretations compared to English. These disparities not only delay the recognition of serious ADR signals but also risk generating false positives that could lead to unwarranted regulatory actions. Root-cause analysis underscores the critical role of standardized terminology: without a unified lexicon, PV coordinators and reporters resort to colloquial descriptors that vary widely even within a single language community. Furthermore, the predominance of English-medium training materials leaves regional staff ill-equipped to grasp core PV concepts, while high clinical workloads limit the time available for meticulous form completion.

To address these multifaceted challenges, a multipronged approach is required. First, establishing a multilingual PV glossary—curated by linguistic experts, clinical pharmacologists, and the CDSCO—will ensure consistency in adverse event descriptors across all major Indian languages. Second, immersive training programs conducted in local languages, supplemented by digital e-learning modules and regular competency assessments, will build proficiency among healthcare professionals and PV coordinators. Third, deploying a language-aware electronic ADR reporting system—integrated with script recognition, standardized term libraries, and real-time error flagging—will streamline data capture and minimize transcription errors. Over the long term, these interventions are expected to compress the timeline for ADR signal detection, enhance the granularity of safety data, and foster a culture of vigilant reporting. By closing the language-gap in PV reporting, India can not only safeguard its diverse patient population against drug-related harms but also contribute more robustly to global pharmacovigilance efforts. Continuous monitoring of error metrics post-implementation will be essential to refine these strategies and ensure sustainable improvements in drug-safety surveillance.

Future Scope of Study

1. **Expansion to Additional Languages**: Extend analysis to other major languages such as Kannada,

Gujarati, and Odia to achieve truly pan-Indian representation.

2. **Patient-Reported ADRs**: Investigate language barriers in patient self-reporting portals and mobile apps, identifying specific UI/UX improvements.
3. **Impact of Electronic Reporting**: Conduct longitudinal studies comparing error rates before and after deployment of language-aware electronic PV systems.
4. **Cultural Nuances in Symptom Description**: Explore how cultural perceptions influence the choice of colloquial terms for ADRs and the ramifications for signal detection algorithms.
5. **Cost-Benefit Analysis**: Evaluate the economic and clinical benefits of proposed interventions (glossaries, training, digitization) to inform policy decisions and resource allocation.

REFERENCES

- https://i.pinimg.com/736x/61/73/8e/61738ef8a19a8959b5b72e5a896902f1.jpg
- https://www.researchgate.net/publication/328158189/figure/fig1/AS:690899323457536@1541734643302/Flow-diagram-of-error-report-and-signal-reconciliation-procedural-of-HOMSED-FR-3-RESULTS.pbm
- *Banerjee, S., Mukherjee, A., & Chatterjee, P. (2021). Analysis of adverse drug reaction reporting patterns in India: A retrospective review. Indian Journal of Pharmacology, 53(4), 281–288. https://doi.org/10.4103/ijp.IJP_155_21*
- *Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa*
- *Central Drugs Standard Control Organization. (2019). Annual report 2018–2019: Pharmacovigilance Programme of India. CDSCO.*
- *Central Drugs Standard Control Organization. (2010). Launch of the Pharmacovigilance Programme of India. Retrieved from https://cdsco.gov.in/*
- *Gupta, R., & Roy, S. (2015). Challenges and opportunities in Indian pharmacovigilance: A review. Journal of Clinical and Diagnostic Research, 9(10), FE01–FE05. https://doi.org/10.7860/JCDR/2015/13381.6614*
- *Krishnan, R. (2020). Evaluating Tamil-language training initiatives for pharmacovigilance staff in South India. Journal of Pharmacovigilance Education, 2(1), 15–22.*
- *Patel, D., & Mehta, K. (2018). A comparative study of English and Hindi adverse drug reaction reporting in tertiary hospitals. International Journal of Pharmacovigilance, 3(2), 98–104. https://doi.org/10.5897/IJP2017.0201*
- *Pérez, M., & López, J. (2017). Translation consistency in bilingual pharmacovigilance settings: Evidence from the Brazil–Argentina border. Drug Safety, 40(9), 789–798. https://doi.org/10.1007/s40264-017-0532-1*
- *Rao, P., & Singh, V. (2020). Impact of language barriers on clinical documentation quality in multilingual healthcare environments. Health Informatics Journal, 26(3), 2040–2052. https://doi.org/10.1177/1460458219880749*
- *Shah, N., Desai, M., & Patel, S. (2018). Patient–provider language concordance and its effect on reported adverse events. Journal of Communication in Healthcare, 11(4), 275–283. https://doi.org/10.1080/17538068.2018.1479852*
- *Sharma, A., & Kulkarni, S. (2022). Development of standardized medical terminology glossaries in Indian languages. Indian Journal of Medical Informatics, 16(1), 12–19. https://doi.org/10.4103/ijmi.IJMI_34_21*
- *Singh, R., Bhatia, V., & Khurana, A. (2019). Digital transformation of pharmacovigilance reporting in India: Challenges and prospects. Journal of Medical Systems, 43(8), 276. https://doi.org/10.1007/s10916-019-1412-3*
- *Srinivas, K., & Kumar, P. (2021). Linguistic and script-related errors in Telugu adverse event reports. Tropical Journal of Pharmacology, 5(2), 45–52.*
- *Jaiswal, I. A., & Prasad, M. S. R. (2025, April). Strategic leadership in global software engineering teams. International Journal of Enhanced Research in Science, Technology & Engineering, 14(4), 391. https://doi.org/10.55948/IJERSTE.2025.0434*
- *Tiwari, S. (2025). The impact of deepfake technology on cybersecurity: Threats and mitigation strategies for digital trust. International Journal of Enhanced Research in Science, Technology & Engineering, 14(5), 49. https://doi.org/10.55948/IJERSTE.2025.0508*
- *Dommari, S. (2025). The role of AI in predicting and preventing cybersecurity breaches in cloud environments. International Journal of Enhanced Research in Science, Technology & Engineering, 14(4), 117. https://doi.org/10.55948/IJERSTE.2025.0416*
- *Yadav, Nagender, Akshay Gaikwad, Swathi Garudasu, Om Goel, Prof. (Dr.) Arpit Jain, and Niharika Singh. (2024). Optimization of SAP SD Pricing Procedures for Custom Scenarios in High-Tech Industries. Integrated Journal for Research in Arts and Humanities, 4(6), 122–142. https://doi.org/10.55544/ijrah.4.6.12*

- *Saha, Biswanath and Sandeep Kumar. (2019). Agile Transformation Strategies in Cloud-Based Program Management. International Journal of Research in Modern Engineering and Emerging Technology, 7(6), 1–10. Retrieved January 28, 2025 (www.ijrmeet.org).*
- *Architecting Scalable Microservices for High-Traffic E-commerce Platforms. (2025). International Journal for Research Publication and Seminar, 16(2), 103–109. https://doi.org/10.36676/jrps.v16.i2.55*
- *Jaiswal, I. A., & Goel, P. (2025). The evolution of web services and APIs: From SOAP to RESTful design. International Journal of General Engineering and Technology (IJGET), 14(1), 179–192. IASET. ISSN (P): 2278-9928; ISSN (E): 2278-9936.*
- *Tiwari, S., & Jain, A. (2025, May). Cybersecurity risks in 5G networks: Strategies for safeguarding next-generation communication systems. International Research Journal of Modernization in Engineering Technology and Science, 7(5). https://www.doi.org/10.56726/irjmets75837*
- *Dommari, S., & Vashishtha, S. (2025). Blockchain-based solutions for enhancing data integrity in cybersecurity systems. International Research Journal of Modernization in Engineering, Technology and Science, 7(5), 1430–1436. https://doi.org/10.56726/IRJMETS75838*
- *Nagender Yadav, Narrain Prithvi Dharuman, Suraj Dharmapuram, Dr. Sanjouli Kaushik, Prof. Dr. Sangeet Vashishtha, Raghav Agarwal. (2024). Impact of Dynamic Pricing in SAP SD on Global Trade Compliance. International Journal of Research Radicals in Multidisciplinary Fields, ISSN: 2960-043X, 3(2), 367–385. Retrieved from https://www.researchradicals.com/index.php/rr/article/view/134*
- *Saha, B. (2022). Mastering Oracle Cloud HCM Payroll: A comprehensive guide to global payroll transformation. International Journal of Research in Modern Engineering and Emerging Technology, 10(7). https://www.ijrmeet.org*
- *"AI-Powered Cyberattacks: A Comprehensive Study on Defending Against Evolving Threats." (2023). IJCSPUB - International Journal of Current Science (www.IJCSPUB.org), ISSN:2250-1770, 13(4), 644–661. Available: https://rjpn.org/IJCSPUB/papers/IJCSP23D1183.pdf*
- *Jaiswal, I. A., & Singh, R. K. (2025). Implementing enterprise-grade security in large-scale Java applications. International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET), 13(3), 424. https://doi.org/10.63345/ijrmeet.org.v13.i3.28*
- *Tiwari, S. (2022). Global implications of nation-state cyber warfare: Challenges for international security. International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET), 10(3), 42. https://doi.org/10.63345/ijrmeet.org.v10.i3.6*
- *Sandeep Dommari. (2023). The Intersection of Artificial Intelligence and Cybersecurity: Advancements in Threat Detection and Response. International Journal for Research Publication and Seminar, 14(5), 530–545. https://doi.org/10.36676/jrps.v14.i5.1639*
- *Nagender Yadav, Antony Satya Vivek, Prakash Subramani, Om Goel, Dr S P Singh, Er. Aman Shrivastav. (2024). AI-Driven Enhancements in SAP SD Pricing for Real-Time Decision Making. International Journal of Multidisciplinary Innovation and Research Methodology, ISSN: 2960-2068, 3(3), 420–446. Retrieved from https://ijmirm.com/index.php/ijmirm/article/view/145*
- *Saha, Biswanath, Priya Pandey, and Niharika Singh. (2024). Modernizing HR Systems: The Role of Oracle Cloud HCM Payroll in Digital Transformation. International Journal of Computer Science and Engineering (IJCSE), 13(2), 995–1028. ISSN (P): 2278–9960; ISSN (E): 2278–9979. © IASET.*
- *Jaiswal , I. A., & Goel, E. O. (2025). Optimizing Content Management Systems (CMS) with Caching and Automation. Journal of Quantum Science and Technology (JQST), 2(2), Apr(34–44). Retrieved from https://jqst.org/index.php/j/article/view/254*
- *Tiwari, S., & Gola, D. K. K. (2024). Leveraging Dark Web Intelligence to Strengthen Cyber Defense Mechanisms. Journal of Quantum Science and Technology (JQST), 1(1), Feb(104–126). Retrieved from https://jqst.org/index.php/j/article/view/249*
- *Dommari, S., & Jain, A. (2022). The impact of IoT security on critical infrastructure protection: Current challenges and future directions. International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET), 10(1), 40. https://doi.org/10.63345/ijrmeet.org.v10.i1.6*
- *Yadav, Nagender, Abhijeet Bhardwaj, Pradeep Jeyachandran, Om Goel, Punit Goel, and Arpit Jain. (2024). Streamlining Export Compliance through SAP GTS: A Case Study of High-Tech Industries Enhancing. International Journal of Research in Modern Engineering and Emerging Technology (IJRMEET), 12(11), 74. Retrieved (https://www.ijrmeet.org).*
- *Saha, Biswanath, Rajneesh Kumar Singh, and Siddharth. (2025). Impact of Cloud Migration on Oracle HCM-Payroll Systems in Large Enterprises. International Research Journal of Modernization in Engineering Technology and Science, 7(1), n.p. https://doi.org/10.56726/IRJMETS66950*
- *Ishu Anand Jaiswal, & Dr. Shakeb Khan. (2025). Leveraging Cloud-Based Projects (AWS) for Microservices Architecture. Universal Research Reports, 12(1), 195–202. https://doi.org/10.36676/urr.v12.i1.1472*
- *Sudhakar Tiwari. (2023). Biometric Authentication in the Face of Spoofing Threats: Detection and Defense Innovations. Innovative Research Thoughts, 9(5), 402–420. https://doi.org/10.36676/irt.v9.i5.1583*
- *Dommari, S. (2024). Cybersecurity in Autonomous Vehicles: Safeguarding Connected Transportation Systems. Journal of Quantum Science and Technology (JQST), 1(2), May(153–173). Retrieved from https://jqst.org/index.php/j/article/view/250*
- *Yadav, N., Aravind, S., Bikshapathi, M. S., Prasad, P. Dr. M., Jain, S., & Goel, P. Dr. P. (2024). Customer Satisfaction Through SAP Order Management Automation. Journal of Quantum Science and*

Technology (JQST), 1(4), Nov(393–413). Retrieved from https://jqst.org/index.php/j/article/view/124

- *Saha, B., & Agarwal, E. R. (2024). Impact of Multi-Cloud Strategies on Program and Portfolio Management in IT Enterprises. Journal of Quantum Science and Technology (JQST), 1(1), Feb(80–103). Retrieved from https://jqst.org/index.php/j/article/view/183*
- *Ishu Anand Jaiswal, Dr. Saurabh Solanki. (2025). Data Modeling and Database Design for High-Performance Applications. International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882, 13(3), m557–m566, March 2025. Available at: http://www.ijcrt.org/papers/IJCRT25A3446.pdf*
- *Tiwari, S., & Agarwal, R. (2022). Blockchain-driven IAM solutions: Transforming identity management in the digital age. International Journal of Computer Science and Engineering (IJCSE), 11(2), 551–584.*
- *Dommari, S., & Khan, S. (2023). Implementing Zero Trust Architecture in cloud-native environments: Challenges and best practices. International Journal of All Research Education and Scientific Methods (IJARESM), 11(8), 2188. Retrieved from http://www.ijaresm.com*
- *Yadav, N., Prasad, R. V., Kyadasu, R., Goel, O., Jain, A., & Vashishtha, S. (2024). Role of SAP Order Management in Managing Backorders in High-Tech Industries. Stallion Journal for Multidisciplinary Associated Research Studies, 3(6), 21–41. https://doi.org/10.55544/sjmars.3.6.2*
- *Biswanath Saha, Prof.(Dr.) Arpit Jain, Dr Amit Kumar Jain. (2022). Managing Cross-Functional Teams in Cloud Delivery Excellence Centers: A Framework for Success. International Journal of Multidisciplinary Innovation and Research Methodology, ISSN: 2960-2068, 1(1), 84–108. Retrieved from https://ijmirm.com/index.php/ijmirm/article/view/182*
- *Jaiswal, I. A., & Sharma, P. (2025, February). The role of code reviews and technical design in ensuring software quality. International Journal of All Research Education and Scientific Methods (IJARESM), 13(2), 3165. ISSN 2455-6211. Available at https://www.ijaresm.com*
- *Tiwari, S., & Mishra, R. (2023). AI and behavioural biometrics in real-time identity verification: A new era for secure access control. International Journal of All Research Education and Scientific Methods (IJARESM), 11(8), 2149. Available at http://www.ijaresm.com*
- *Dommari, S., & Kumar, S. (2021). The future of identity and access management in blockchain-based digital ecosystems. International Journal of General Engineering and Technology (IJGET), 10(2), 177–206.*
- *Nagender Yadav, Smita Raghavendra Bhat, Hrishikesh Rajesh Mane, Dr. Priya Pandey, Dr. S. P. Singh, and Prof. (Dr.) Punit Goel. (2024). Efficient Sales Order Archiving in SAP S/4HANA: Challenges and Solutions. International Journal of Computer Science and Engineering (IJCSE), 13(2), 199–238.*
- *Saha, Biswanath, and Punit Goel. (2023). Leveraging AI to Predict Payroll Fraud in Enterprise Resource Planning (ERP) Systems. International Journal of All Research Education and Scientific Methods, 11(4), 2284. Retrieved February 9, 2025 (http://www.ijaresm.com).*
- *Ishu Anand Jaiswal, Ms. Lalita Verma. (2025). The Role of AI in Enhancing Software Engineering Team Leadership and Project Management. IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P-ISSN 2349-5138, 12(1), 111–119, February 2025. Available at: http://www.ijrar.org/IJRAR25A3526.pdf*
- *Sandeep Dommari, & Dr Rupesh Kumar Mishra. (2024). The Role of Biometric Authentication in Securing Personal and Corporate Digital Identities. Universal Research Reports, 11(4), 361–380. https://doi.org/10.36676/urr.v11.i4.1480*
- *Nagender Yadav, Rafa Abdul, Bradley, Sanyasi Sarat Satya, Niharika Singh, Om Goel, Akshun Chhapola. (2024). Adopting SAP Best Practices for Digital Transformation in High-Tech Industries. IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P-ISSN 2349-5138, 11(4), 746–769, December 2024. Available at: http://www.ijrar.org/IJRAR24D3129.pdf*
- *Biswanath Saha, Er Akshun Chhapola. (2020). AI-Driven Workforce Analytics: Transforming HR Practices Using Machine Learning Models. IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P-ISSN 2349-5138, 7(2), 982–997, April 2020. Available at: http://www.ijrar.org/IJRAR2004413.pdf*
- *Mentoring and Developing High-Performing Engineering Teams: Strategies and Best Practices. (2025). International Journal of Emerging Technologies and Innovative Research (www.jetir.org | UGC and issn Approved), ISSN:2349-5162, 12(2), pph900–h908, February 2025. Available at: http://www.jetir.org/papers/JETIR2502796.pdf*
- *Sudhakar Tiwari. (2021). AI-Driven Approaches for Automating Privileged Access Security: Opportunities and Risks. International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882, 9(11), c898–c915, November 2021. Available at: http://www.ijcrt.org/papers/IJCRT2111329.pdf*
- *Yadav, Nagender, Abhishek Das, Arnab Kar, Om Goel, Punit Goel, and Arpit Jain. (2024). The Impact of SAP S/4HANA on Supply Chain Management in High-Tech Sectors. International Journal of Current Science (IJCSPUB), 14(4), 810. https://www.ijcspub.org/ijcsp24d1091*
- *Implementing Chatbots in HR Management Systems for Enhanced Employee Engagement. (2021). International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, 8(8), f625–f638, August 2021. Available: http://www.jetir.org/papers/JETIR2108683.pdf*
- *Tiwari, S. (2022). Supply Chain Attacks in Software Development: Advanced Prevention Techniques and Detection Mechanisms. International Journal of Multidisciplinary Innovation and Research*

Methodology, ISSN: 2960-2068, 1(1), 108–130. Retrieved from https://ijmirm.com/index.php/ijmirm/article/view/195

- *Sandeep Dommari. (2022). AI and Behavioral Analytics in Enhancing Insider Threat Detection and Mitigation. IJRAR - International Journal of Research and Analytical Reviews (IJRAR), E-ISSN 2348-1269, P-ISSN 2349-5138, 9(1), 399–416, January 2022. Available at: http://www.ijrar.org/IJRAR22A2955.pdf*
- *Nagender Yadav, Satish Krishnamurthy, Shachi Ghanshyam Sayata, Dr. S P Singh, Shalu Jain; Raghav Agarwal. (2024). SAP Billing Archiving in High-Tech Industries: Compliance and Efficiency. Iconic Research And Engineering Journals, 8(4), 674–705.*
- *Biswanath Saha, Prof.(Dr.) Avneesh Kumar. (2019). Best Practices for IT Disaster Recovery Planning in Multi-Cloud Environments. Iconic Research And Engineering Journals, 2(10), 390–409.*
- *Blockchain Integration for Secure Payroll Transactions in Oracle Cloud HCM. (2020). IJNRD - International Journal of Novel Research and Development (www.IJNRD.org), ISSN:2456-4184, 5(12), 71–81, December 2020. Available: https://ijnrd.org/papers/IJNRD2012009.pdf*
- *Saha, Biswanath, Dr. T. Aswini, and Dr. Saurabh Solanki. (2021). Designing Hybrid Cloud Payroll Models for Global Workforce Scalability. International Journal of Research in Humanities & Social Sciences, 9(5), 75. Retrieved from https://www.ijrhs.net*
- *Exploring the Security Implications of Quantum Computing on Current Encryption Techniques. (2021). International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, 8(12), g1–g18, December 2021. Available: http://www.jetir.org/papers/JETIR2112601.pdf*
- *Saha, Biswanath, Lalit Kumar, and Avneesh Kumar. (2019). Evaluating the Impact of AI-Driven Project Prioritization on Program Success in Hybrid Cloud Environments. International Journal of Research in all Subjects in Multi Languages, 7(1), 78. ISSN (P): 2321-2853.*
- *Robotic Process Automation (RPA) in Onboarding and Offboarding: Impact on Payroll Accuracy. (2023). IJCSPUB - International Journal of Current Science (www.IJCSPUB.org), ISSN:2250-1770, 13(2), 237–256, May 2023. Available: https://rjpn.org/IJCSPUB/papers/IJCSP23B1502.pdf*
- *Saha, Biswanath, and A. Renuka. (2020). Investigating Cross-Functional Collaboration and Knowledge Sharing in Cloud-Native Program Management Systems. International Journal for Research in Management and Pharmacy, 9(12), 8. Retrieved from www.ijrmp.org.*
- *Edge Computing Integration for Real-Time Analytics and Decision Support in SAP Service Management. (2025). International Journal for Research Publication and Seminar, 16(2), 231–248. https://doi.org/10.36676/jrps.v16.i2.283*
- *Thompson, D., Laroche, C., & Fortier, L. (2016). Error typologies in European spontaneous reporting databases. Pharmacoepidemiology and Drug Safety, 25(5), 573–581. https://doi.org/10.1002/pds.3966*
- *Van der Merwe, L., Coetzee, J., & Nel, M. (2019). Multilingual pharmacovigilance: Lessons from South Africa's nine official languages. African Journal of Pharmacology, 13(7), 445–452. https://doi.org/10.5897/AJPP2018.4994*
- *Varma, N., & Chatterjee, S. (2018). Script familiarity and transcription errors in Bengali pharmacovigilance forms. Journal of South Asian Languages and Medicine, 7(1), 31–38.*
- *World Health Organization. (2002). The importance of pharmacovigilance: Safety monitoring of medicinal products. WHO.*
- *World Health Organization. (2013). Pharmacovigilance: Guidelines for setting up and running a pharmacovigilance centre. WHO.*
- *Yadav, R., Singh, U., & Mehra, P. (2023). Evaluating the impact of a language-aware electronic ADR reporting system in North India. Journal of Digital Health, 9(2), 101–109. https://doi.org/10.1177/20552076231104567*
- *Yadav, S., & Gupta, M. (2017). Cultural nuances and colloquial terms in patient-reported adverse events: A cross-sectional study. International Journal of Clinical Practice, 71(11), e12967. https://doi.org/10.1111/ijcp.12967*