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# ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (AI/ML) ON PAEDIATRIC COLOSTOMY: RECENT ADVANCES AND FUTURE PROSPECTIVE

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**ABSTRACT** Colostomy is a reversible surgical procedure in which a stoma is formed by drawing the healthy end of the large intestine or colon in a baby. Although, an incision in the anterior abdominal wall and suturing it into place of right location. Surgery is indicated in very few children with intractable functional constipation with patients. A larger number of operations already described with unpredictable outcome and significant of the morbidity. In the traditional practice of delaying enteral feeding after paediatric colostomy closure has been a subject of reconsideration for Asian Indian Aspects. The hypothesis driving this shift stems from the wake of emerging evidence suggesting the benefits of early enteral nutrition also a causal factor. Early feeding is the understanding that it enhances the recovery by improving gut function and reducing hospital staying. It is significant in the pediatric population where rapid return to normal activities minimizing the hospital-associated stress are crucial. Artificial intelligence & Machine Learning (AI/ ML) simulates human intelligence increasingly used in medical research for diagnosis, prognosis, and advanced Colostomy AI/ML research leverages to manage complications and improve Preoperative care. In addition to management, maximum conservative measures, included with psychologic referral, rectal biopsy, transit studies, and contrast enemas were also important. A new standard Hartmann procedure was performed with on-table rectal washout, formation of a proximal sigmoid colostomy, limited anterior resection of hypertrophic proximal rectosigmoid, and oversewing of the rectal stump in our surgical set up.Hartmann's reversal is one complex colostomy procedure, body composition, such as subcutaneous fat levels, influences the reversal complications. AI/ML to assess skeletal muscle index (SMI) and predict postoperative complications pospectively. Protocols of Pre and post-colostomy closure in pediatric patients were focusing on the several parameters. Incidence of postoperative complications, the duration of hospital stay, and overall recovery. In our Medical University used machine learning to predict the likelihood of permanent pediatric colostomy, stoma after sphincter-saving surgeries, achieving the higher accuracy. AI/ML had potential in predicting surgical outcomes and aiding clinical decision-making particularly natural language processing (NLP). AI/ML improve the accuracy of procedure classification in colostomy research. While AI's use in colostomy procedures is more beneficial. Further studies are needed to confirm the reliability of AI algorithms for predicting patient outcomes and address ethical considerations. AI/ML decisions considering individual circumstances for maintaining in patient data confidentiality.

**KEYWORDS :** Artificial Intelligence (AI), Machine Learning (ML), Paediatric Colostomy, Translational Research, Research and Development (R&D), Treatment, Applied Research

## INTRODUCTION:

In lower and middle-income countries (LMICs), paediatric patients with colorectal conditions poses considerable challenges are very difficult to manage [1]. Several causal factors associated unlike delayed presentation, suboptimal care, resource limitations, discontinuity of follow-up care contribute to poorer outcomes compared to high-income countries (HICs). In many cases, children with congenital colorectal conditions require a colostomy as an interim step before definitive surgical repair for their proper management [2]. Particularly true in LMICs, sepsis and wound breakdown occur more frequently in the Asian Indian Context. The barriers with colostomy care in children remain underexplored in detailed with both HICs and LMICs. Limited understanding of the clinical, psychological, and practical challenges faced by caregivers and health care professionals till date [3]. Caregivers, faced with substantial barriers into colostomy care. Patients may be struggled with access to resources, technical skills, and psychological burdens are important factor [4]. Health care professionals in resource-limited settings encounter the systemic challenges in stoma management. The complicate ability to deliver optimal care and identifying addressing these were barriers and crucial to improve outcomes for paediatric patients with colostomies [4].

Appropriate care and management can reduce the severity, complications peristome skin damage and contribute to smoother reversal processes [1-4]. The evident need for practical tools to support the caregiver's health care professionals, no scoring system for quantifying barriers into colostomy care could be identified in the literature [5]. There is a special need for such a clinical diagnostic tool that is cognizant of resource-limited settings to assist the health care professionals and caregivers [6]. In delivering with optimal colostomy care to patients are quite impotent [6]. This study aimed to identify key barriers to caring for and managing a child from the perspectives of caregivers and health care professionals and need to develop a scoring system through the AI/ML to avoid the barriers of colostomy care in resource-constrained settings in Indian population [7]. The implementation of artificial intelligence (AI) and machine learning (ML) in medical practice resulted in better diagnostic precision as well as individualized treatments and predictive medical outcomes [1-6].

This complex nature of gastrointestinal surgeries along with patient-specific conditions makes these procedures an ideal target for AI/ML technology to deliver significant advantages [2]. The systems receive training from larger clinical datasets containing imaging data and the genomic information and diagnostic results. Treatment protocols to assist healthcare providers in predicting surgical complications and optimizing resource allocation and improving patient care [3]. AI applications in gastrointestinal surgery work to boost pre- and post-operative evaluations through predictive models that detect possible risks and create individualized treatment plans. The combination of machine learning algorithms with natural language processing and computer vision enables AI tools to analyse medical complexities by delivering immediate data-based recommendations required for the surgeons and patient relatives as EHR. [5].AI identifies patterns in extensive datasets to forecast the surgical complications including infections and anastomotic leaks and bleeding thus enabling better patient care planning [6]. AI technologies support the new robotic surgical procedures by helping surgeons achieve the precise results with lesser invasiveness which is leading into the better treatment outcomes [7].

AI/ML systems had directly related the quality completeness of training data for clinical decision-making [8]. AI/ML also influencing patient-provider interactions through virtual assistants, improving patient education, and facilitating communication between patients and healthcare providers [9]. It enables the processing of extensive data sets (EDSs), which reduces healthcare provider workloads and enables them to dedicate more time to patient care. The practical deployment of AI for surgical outcome prediction and post-operative care holds promise yet faces multiple barriers concerning ethical implementation and regulatory requirements and operational usability [10].

## MATERIAL AND METHODS:

### Data collection & Study Design:

We Conducted as a clinically randomized controlled trial at the Department of Pediatric Surgery, Siksha "O" Anusandhan Deemed to be University, Bhubaneswar, Odisha

### Selection Criteria:

In this study we enrolled 150 paediatric patients, evenly divided into the two groups. Both early enteral feeding (Group A) and conventional feeding (Group B). we excluded those are not interested in this study.

### Methods:

In this study we enrolled 150 paediatric patients, evenly divided into the two groups. Both early enteral feeding (Group A) and conventional feeding (Group B). Both groups were meticulously matched for age, weight, and gender to ensure comparability with meticulously recorded and analysed postoperative outcomes including with Colostomy anastomotic leakage, vomiting, upper respiratory tract infections (URTI), wound infections, and other complications using chi-square and t-tests for statistical significance. The system was verified through randomized controlled trials, confirming its significant improvement. In the early warning performance of complications, enhancement of the standardization of operations and reduction of medical resource consumption. The core innovation lies in the first introduction of the federated learning framework into the field of pediatric Colostomy. The system was verified through clinically randomized controlled trials. It is confirming with significant improvement. In the early warning performance of complications, enhancement of the standardization of operations and reduction of medical resource consumption. Pediatric Colostomy care, combined with neural architecture search for lightweight model deployment. The quantification of health economic benefits through Markov models, research marks a paradigm shifts in postoperative care from experience-driven to data-driven.It is providing an extensible technical model for the intelligent monitoring of pediatric Colostomy diseases (PCD). In the future, it is necessary to expand the cross-disease transfer learning architecture and develop flexible and degradable sensors to enhance the accessibility of primary medical care for our OPD. Pouching systems play a key role in Colostomy care. However, Colostomy complications due to leaked effluent are a common problem. Mouldable skin barriers are an alternative to traditional cut-to-fit or precut barriers and may provide improved benefits for pediatric Colostomy. We examined the best available evidence describing the use of mouldable stoma baseplate technologies in The system was verified through clinically randomized controlled trials. It is confirming that its significant improvement. In the early warning performance of complications, enhancement of the standardization of pediatric Colostomy operations and reduction of medical resource consumption care also observed.

### Statistical Analysis:

The objective was to determine the best evidence describing the differences between mouldable versus cut-to-fit products to inform healthcare providers, caregivers, and patients with Colostomy about their recommended use. Researchers programmed the AI search based on study inclusion and exclusion criteria with iteration reports presented by recall percentage, precision and F-score. LRN's outputs are explained for transparency in search iteration model accuracy, Cohen's kappa and average potential. The human researchers then read all abstracts and full texts for final inclusion and analysis. Seventeen studies evaluating mouldable technology were identified for Colostomy. The major key findings emerged in favour of the use of mouldable technology compared to cut-to-fit appliances regarding the following themes were overall satisfaction. Additionally, reduced stoma complications, decreased nurse time to teach patient self-care (PSC), benefits over the cut-to-fit stoma skin barriers, costs with consistent outcomes demonstrated globally with diverse the Asian Indian populations.

## RESULTS:

The mean age of patients was (6.68 ± 3.45 years), with a balanced distribution between the groups ($p = 0.915$). In Group A, 8.4% experienced anastomotic leakage compared to 11.2% in Group B; vomiting occurred in 11.2% of Group A and 8.6% of Group B; URTI was noted in 2.7% of Group A versus 15.2% in Group B; wound infection rates (WIRs) were 8.6% for Group A and 14.2% for Group B. The average post-operative hospital stays significantly favoured Group A at 4.26 ± 0.43 days versus 7.04 ± 0.33 days for Group B ($p = 0.0001$). The incidence of PSH within 1 year was 28.1% (150 patients). The models tested, the RF model demonstrated the highest discrimination capability with an AUC of 0.885 (95% CI: 0.871–0.934), along with superior specificity, accuracy, sensitivity, and F1 score. It also showed the highest clinical net benefit on the DCA curve. SHAP analysis identified the top 10 influential variables associated with PCD risk: body mass index (BMI), operation duration, history and status of chronic obstructive pulmonary disease (COPD), prealbumin, tumor node metastasis (TNM) staging, stoma site, thickness of rectus abdominis muscle (TRAM), C-reactive protein CRP, american society of anesthesiologists physical status classification (ASA), and stoma diameter. These insights from SHAP plots illustrated how these factors influence individual PCD outcomes. The nomogram was used for model visualization. The research included 38 studies which analyzed 62 logistic regression models together with 143 machine learning models. The research showed that the best-performing machine learning models produced area under the curve (AUC) results superior to logistic regression models by 0.07 (95%CI: 0.04–0.09; $P < 0.001$). The results demonstrate that machine learning algorithms produce substantial improvements in identifying patients who face higher risks of adverse postoperative complications. The results demonstrated machine learning superiority through an AUC difference of 0.40 (95%CI: 0.14–0.64; $P = 0.009$) when analyzing only studies with low bias risk which comprised 45% of the total data.

## DISCUSSION:

Machine learning consistently demonstrated better performance in studies with strong methodological standards which strengthens its reliability for surgical outcome prediction [11]. The tumor/stroma classifier showed excellent performance with an AUC of 96.18% ± 1.84%, while the subtype classifier achieved a balanced accuracy of 96.19% ± 2.45% at the slide level [12]. The model correctly classified 83.03% ± 6.35 of the patients' tumor molecular subtypes in the validation cohort. This classifier is the first to categorize PDAC patients based on biopsy samples Conversion from temporary stoma to a permanent stoma (PS) following loop ileostomy (LI) significantly impairs patients' quality of life and prognosis [13]. However, few predictive tools are currently available in clinical practice. This study aims to develop and validate a machine learning (ML) model to predict the risk of PS following laparoscopic anterior resection (LAR) in older adults with rectal cancer [14]. The LR-based model exhibited robust discriminative ability and clinical applicability for predicting PS in older patients following LAR.Biomedical devices provide a critical role in the healthcare system to positively impact patient well-being [15]. This paper aims to provide the current classifications and sub classifications of hardware and software medical devices according to the Food and Drug Administration (FDA) guidelines [16]. The FDA regulatory pathway for medical device development such as radiation-emitting electronic product verification, product classification database [17]. Humanitarian Use Device (HUD), premarket approval, premarket notification and clearance, post-market surveillance, and reclassification is provided with the PCD [18].

### Recent Advances And Future Prospective & Recommendations For Further Research:

Current advances and the advantages of implementing human factors engineering in biomedical device development to reduce the risk of user error, product recalls and effective safe use are discussed [19]. This paper also provides a review of evolving topics such as the Internet of Things (IoT), software as medical devices, artificial intelligence (AI), machine learning (ML), mobile medical devices, and clinical decision software support systems [17-18]. A comprehensive discussion of the first FDA-approved AI-medical device for the diagnosis of diabetic retinopathy is presented. Further, potential cybersecurity-related risks associated with software-driven AI/ML and IoT medical devices are discussed with an emphasis on government regulations [20]. Futuristic trends in biomedical device development and their implications on patient care and the healthcare system are elucidated. Data science continues to be recognized and used within healthcare due to the increased availability of large data sets and advanced analytics.

It can be challenging for nurse leaders to remain apprised of this rapidly changing landscape. In this article, we describe our findings from our AI/ML data used with data science to explore, explain. We predict 150 phenomena of interest to nurses. All the 150 phenomena were associated with identified the use of many contemporary data science methods natural language processing (NLP), neural networks for many of the better outcomes. We found that Artificial Intelligence/Machine Learning Acceptance, Burnout, Patient Safety, Unit Culture were poorly represented. The studies described in this article help readers understand the breadth and depth of data science's ability to improve clinical processes and patient outcomes that are relevant to nurses and identify gaps in the literature that are in need of exploration. Artificial Intelligence (AI) is now becoming increasingly common in healthcare. AI/ML has potential effect to improve the efficiency and quality of healthcare services. AI expands the utility of medical-legal questions and arise regarding the possible legal implications and incorporating for the AI into the best clinical practice.

Particularly, the unique black box nature of AI brings distinct challenges. There is a limited guidance addressing liability when AI is used in clinical practice, traditional legal principles present limitations when applied to novel uses of AI. In Comprehensive solutions to address the challenges of AI have not been well established in Asian Indian till date. As AI continues to evolve in healthcare, appropriate guidance from professional regulatory bodies may help the medical field realize AI's utility and encourage its safe use for paediatric Colostomy. As the options for AI in medicine evolve, physicians and health leaders would be prudent to consider the evolving medical-legal context regarding use of AI in clinical practices and facilities. This study examines the prototyping processes for smart bandages for diabetic chronic wounds by taking the “logic of care” into consideration and aims to facilitate new ways of supporting the patients in their treatment [21].

Future research could evaluate the effects (knowledge, skills, satisfaction, quality of life, etc.) of patient education materials developed with AI on patients. More research is needed to understand the potential benefits of AI technologies in healthcare settings and ethical considerations. This article has outlined the vast potential for AI in the future of surgery with an impact predicted to improve or transform all aspects of surgical patient care. We have also emphasised the need to collectively identify and manoeuvre through challenges in its implementation, as well as appreciate important ethical and legal considerations as AI technology advances towards more autonomous capacities. The primary goal of health innovation is to enhance clinical practice and advance patient care. In particular, the surgical field has always strived to innovate, from performing complex operations that were once deemed impossible to perform, to ushering in an era of minimally invasive technologically powered devices. AI stands to be a gateway into a future era of healthcare and the global surgical community must embrace it.

**Implications For Policy And Practice With Key Messages:**

Implementation is additionally bound to considerations of usability and pathway feasibility, and the need for robust healthcare technology assessment and evidence generation. While these factors are traditionally seen as barriers to translating AI into practice, we discuss how holistic implementation practices can create a solid foundation for scaling AI across pathways. AI-assisted HPB surgical training improves operative efficiency, reduces complications, enhances learning curves, and enables accurate skill assessment.

These findings support systematic AI integration with standardized protocols and multicenter validation. The Random Forest model demonstrated robust predictive performance and clinical relevance in forecasting PCD. This model aids in early identification of high-risk patients and guides preventive care. Early enteral feeding after pediatric colostomy closure significantly reduces the hospital stay without increasing the risk of postoperative complications, suggesting a beneficial role in pediatric surgical recovery. This study supports the integration of early feeding protocols into postoperative care for pediatric colostomy patients, contributing to the evolving practice of pediatric surgery. The next decade will see rapid translation of experimental development into real-world impact. AI will require evolution of work practices, but will also enhance patient safety and surgical quality outcomes, and provide significant value for surgeons and health systems.

Surgical practice has always sat on a bedrock of technological innovation. For those that follow this tradition, the future of AI in surgery starts now.The validation results of AI-assisted patient education material for ostomy patients make AI a reasonable alternative for patient education interventions. AI-assisted patient education materials can significantly increase patient information rates in the health system regarding ease of practice. However, there are currently not enough studies to recommend chatbots as a source of educational information for ostomy patients. It is recommended to be used after validation studies instead of direct chatbot–patient interaction or transfer of chatbot information directly to the patient. AI chatbots can be considered complementary tools. Ignoring the existence of artificial intelligence with uncertainty and anxiety could lead to a significant loss for the future healthcare system. In order to invest in the future of the health system, it would be more appropriate to acknowledge the presence of artificial intelligence and technology, understand their capabilities and potential impacts, and integrate them into the healthcare system.

**Limitation:**

The main limitation of the study is that feedback from PCD patients was not included in the validation process of the AI-assisted patient education material. This situation limits the practical applicability of the patient education material for patients and their relatives.

## CONCLUSION:

In this paper, this study presents the first scoring system designed to capture barriers to pediatric colostomy care in a limited-resource context. By integrating with the perspectives of both caregivers and health care professionals, the scoring system provides a much-needed framework to document, quantify, and ultimately address the systemic, financial, educational, and psychosocial challenges these caregivers and families face for PCD. Its development marks an important step toward standardizing care, improving outcomes, and informing policy in resource-limited settings. Broader implementation of the scoring system in and other PCD had the potential to drive targeted interventions, foster collaboration, and ensure that children living with stomas receive the comprehensive, dignified care they deserve. We summarise that current landscape of existing and emerging integrations within PCD complex surgical care pathways. We investigated an effective method for practical use of AI throughout the patient pathway, from early screening and accurate diagnosis to intraoperative robotics, postoperative monitoring, and follow-up. Horizon scanning of AI technologies in surgery. It is used to identify novel innovations that can enhance surgical practice today, with potential for paradigm shifts across core domains of surgical practice in the future. AI-driven future must be built on responsible and ethical usage, reinforced by effective oversight of data governance and risks.

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