OPENING THE PERSONAL GATE BETWEEN TECHNOLOGY AND HEALTH CARE

Studies in Health Technology and Informatics

Internationally, health informatics is driven by developments in biomedical technologies and medical informatics research that are advancing in parallel and form one integrated world of information and communication media and result in massive amounts of health data. These components include genomics and precision medicine, machine learning, translational informatics, intelligent systems for clinicians and patients, mobile health applications, data-driven telecommunication and rehabilitative technology, sensors, intelligent home technology, EHR and patient-controlled data, and Internet of Things.

The series Studies in Health Technology and Informatics (HTI) was started in 1990 in collaboration with EU programmes that preceded the Horizon 2020 to promote biomedical and health informatics research. It has developed into a highly visible global platform for the dissemination of original research in this field, containing more than 250 volumes of high-quality works from all over the world.

The international Editorial Board selects publications with relevance and quality for the field. All contributions to the volumes in the series are peer reviewed.

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Opening the Personal Gate between Technology and Health Care

Proceedings of MIE 2026

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Preface

The 36th Medical Informatics Europe Conference, MIE 2026, will be held from 25 to 28 May 2026 in Genoa, Italy. The Conference is co-hosted by the Italian Scientific Society of Biomedical Informatics (SIBIM) and the European Federation for Medical Informatics (EFMI). The Scientific Programme Committee is chaired by Professor Mauro Giacomini and co-chaired by Professor Jaime Delgado.

The theme of MIE 2026 is "Opening the Personal Gate between Technology and Health Care". As the editors of the proceedings of MIE 2025: Intelligent Health Systems – From Technology to Data and Knowledge, have already pointed out, artificial intelligence (AI) continues to be overestimated worldwide, even within the scientific community, and greater caution should be exercised in assessing the evolution of the technologies at our disposal. No technology can ever be a panacea for all the problems we face as we employ our tools in the fight to improve the health of humanity and all of creation. To be effective, technological solutions must be integrated into the healthcare process, providing high-quality data that is appropriately contextualised to deliver meaningful information to authorised users. But, as has always been the case in the course of human development, knowledge can only arise from an open dialogue among all those involved in the process. This is precisely the objective of this edition of EFMI MIE2026, which takes place on the 50th anniversary of the EFMI in Genoa, Italy, a city which for centuries has served as a gateway to the Mediterranean basin and all other routes of human enterprise.

These proceedings present the current trends in health and biomedical informatics. The contributions cover topics like biomedical imaging and data science; computable knowledge and decision support; ethics, explainable and trustworthy AI; generative AI and natural language processing; standardisation, interoperability, FAIR data and European health data space; information systems in healthcare; personalised medicine; telemedicine and telehealth; OneHealth; education; and human centred digital health.

The proceedings are published by Sage Publishing / IOS Press as an e-book in the open access series Studies in Health Technology and Informatics (HTI). Volumes in the HTI-series are submitted (for evaluation) for indexing by MEDLINE/PubMed; Web of Science: Conference Proceedings Citation Index – Science (CPCI-S) and Book Citation Index – Science (BKCI-S); Google Scholar; Scopus, and EMCare.

The Editors,
Mauro Giacomini, Jaime Delgado, Theodoros N. Arvanitis, Elisavet Andrikopoulou, Arriel Benis, Gabriella Balestra, Riccardo Bellazzi, Parisis Gallos, Roberto Gatta, Daniele Roberto Giacobbe, Noemi Giordano, Maria Hägglund, Lars Lindsköld, Lenka Lhotska, Sara Marceglia, Enea Parimbelli, Paolo Soda, Lăcrămioara Stoicu-Tivadar, Pierangelo Veltri, Patrizia Vizza.

Genoa, 8 April 2026

About the Conference

The Conference

The Italian Scientific Society of Biomedical Informatics (SIBIM), together with the European Federation for Medical Informatics (EFMI), organised the 36th Medical Informatics Europe Conference (MIE2026) MIE2026, which took place from 25 to 28 May 2026 in Genoa, Italy. The theme of the conference was "Opening the Personal Gate between Technology and Health Care" (https://mie2026.efmi.org/). The conference was managed by the professional conference organiser Pragma Congressi, Pavia, Italy.

Founded in 1976, EFMI is the leading organisation in medical informatics in Europe, and represents 33 countries through their respective national health informatics associations. EFMI is a not-for-profit organisation concerned with the theory and practice of information science and technology within healthcare and health sciences in a European context.

MIE is a series of medical informatics conferences that aim to promote research and development in biomedical and health informatics. Members of the global medical informatics community are invited to take part in each conference as presenters or participants. Each conference consists of scientific sessions with oral presentations of peer-reviewed full papers and short communication papers. Each conference also includes panels, workshops, demos, and tutorials, some prepared by EFMI working groups. A large exhibition of peer-reviewed posters also forms part of each conference.

Conference Topics included (but were not limited to):

- ARTIFICIAL INTELLIGENCE IN MEDICINE
  - Biomedical imaging in medical informatics
  - Computable knowledge and decision support
  - Data science for visualisation and analytics
  - Ethics, regulations and AI
  - Explainable and trustworthy AI
  - Generative AI, foundational models
  - Learning health systems
  - Natural language processing applications in healthcare

- INFRASTRUCTURES AND REGULATIONS
  - FAIR data and data sharing infrastructures, European Health Data Space
  - Healthcare data security
  - Information Infrastructure Integration and certification

  - Information systems in healthcare
  - Privacy and data protection methods and technologies for healthcare
  - Standardisation and interoperability issues in medical informatics

- HEALTH INFORMATICS ECOSYSTEMS
  - Automation and robotics in healthcare
  - Digital twins
  - Digitally supported Precision Medicine
  - Internet of Medical Things
  - Medical devices (including software)
  - Patient empowerment
  - Personal health records and mHealth
  - Telemedicine and telehealth

- ONEHEALTH
  - Human factors, social and organisational issues
  - Population health
  - Translational health informatics
  - Veterinary and environmental health informatics

- EDUCATION
  - Health Informatics in medical education
  - Innovative technologies and approaches for education
  - Living labs and patients' inclusion and engagement
  - Multimodal Learning in healthcare

- HUMAN CENTRED DIGITAL HEALTH

The MIE2026 conference included three keynote speeches by internationally recognised experts in medical informatics:

- **Silvana Quaglini** has an MS degree in Electronic Engineering and PhD in Bioengineering, and is a full professor of Medical Informatics at the University of Pavia, Italy. Her research focuses on decision support systems, home monitoring and care, and the economic evaluation models of healthcare interventions. The main medical areas covered by these applications include cancer, stroke, chronic diseases, and cognitive rehabilitation. The recent push towards personalised medicine has directed her latest studies toward shared decision-making and context-aware home monitoring. She has consistently conducted applied research, mainly within EU-funded projects, collaborating with local and international hospitals. She is a past-president of SIBIM (Italian Society of Biomedical Informatics, EFMI member), member of the GNB (National Bioengineering Group), and the author of approximately 350 scientific publications, with an h-index of 47 (2025, Scopus).

- **Johan Gustav Bellika** has worked at the intersection between medicine, medical research and informatics since 1992, when he joined the Department of Community Medicine at UiT The Arctic University of Norway. He has worked at the Norwegian centre for e-health research at the University Hospital of North Norway since 1997. In the period between 2007 and 2013 he joined the department of computer science to teach and research in relation to the international master programme in Telemedicine and e-health. He is now a professor in medical informatics at the department of clinical medicine, Faculty of health sciences at UiT The Arctic University of Norway and the Norwegian Centre for E-health Research at the University hospital of North Norway. His current research focus is on technology to enable privacy-preserving reuse of health data and supporting a learning healthcare system.

- **Giorgio Cangioli** is a Senior Consultant in Digital Health and Social Care and an internationally recognised expert in healthcare interoperability and standards. He actively contributes to European initiatives supporting the European Health Data Space (EHDS). He is an HL7 Fellow, Technical Lead and Board Member of HL7 Europe, and a member of the HL7 International Technical Steering Committee. He also chairs the European eHMSEG (eHealth Member States Expert Group) Semantic Task Force Architecture Working Group. With more than 25 years of experience, Giorgio specialises in ICT, standards, and business process re-engineering in health and social care. Throughout his career, he has contributed to standardisation activities within HL7, CEN, ISO, IHE, and DICOM, and has facilitated multiple European and global standardisation initiatives. He is one of the authors of the International Patient Summary (IPS) standards (ISO/EN 27269 and HL7 IPS FHIR Implementation Guide).

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- Mauro Giacomini: Department of Informatics, Bioengineering, Robotics and System Engineering, University of Genoa, Italy
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Editors

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Editorial Committee

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- Elisavet Andrikopoulou, EFMI Publications Officer, EFMI Exec Board Member, Faculty of Technology, School of Computing, University of Portsmouth, UK.
- Parisis Gallos, Past EFMI Publications Officer; ICU Follow up – Care Research Lab, Department of Nursing, University of West Attica, Greece.

Peer Review Process

We received 884 submissions from 57 countries. A thorough review process was conducted with valuable support from 385 active reviewers. Almost all submissions were reviewed by at least three reviewers and assessed by one SPC co-chair. Based on their recommendations, final decisions were made by SPC members during a three-day virtual meeting. Papers requiring major revision underwent a further review by SPC members.

Finally, from among the 582 full papers, 103 short communication papers, 80 posters, 34 demonstrations, 25 panels, 54 workshops, and 6 tutorials submitted, 415 full papers (acceptance rate of 71%), 91 short communication papers (conversion of 29 full papers), 117 posters (conversion of 50 full papers and 15 short communications), 29 demonstrations, 26 panels (conversion of 3 workshops), and 26 workshops were accepted. All accepted full papers, short communication papers, and posters are included in these proceedings. Notably, this collection encompasses contributions originating not only from Europe (the primary geographic focus of Medical Informatics Europe 2026) but also from various other continents. This international participation highlights the global significance of sharing knowledge and practical experiences related to scientific and implementation challenges in healthcare informatics. We firmly believe that such global exchange provides valuable insights and meaningful learning opportunities for the European community and beyond.

We want to thank the Editors and the Editorial Committee, and all the reviewers for their invaluable contributions to MIE2026.

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Extraction of Endoscopic Markers from Clinical Notes in Italian Patients with Autoimmune Atrophic Gastritis Using Small Language Models

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Abstract. While Large Language Models (LLMs) hold great potential for clinical applications, their use is limited by concerns regarding data privacy, high computational demand, and the risk of hallucinations. Small Language Models (SLMs) are a promising solution, enabling efficient and secure on-device processing. This study presents the application of a local IT5 model finetuned to extract endoscopic markers from Italian annotated clinical notes of patients with Autoimmune Atrophic Gastritis (AAG). The results show that this model performs competitively with both GPT-4o mini—a general-purpose model—and MedGemma—a medical-oriented model—in this specific task, achieving high sensitivity, which is crucial for rare disease detection. These findings highlight the advantages of local, task-specific SLMs for privacy-preserving applications within healthcare settings.

Keywords. Biomedical Information Extraction, Clinical Text, Small Language Models, Natural Language Processing.

1. Introduction

In the last years, Large Language Models (LLM) have shown to be promising in clinical applications, as they can be efficiently used for several tasks such as providing assistance in summarizing clinical notes, improving communications with patients, supporting diagnoses and treatments. However, their actual implementation in the clinical context is not currently simple.

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Data privacy, risks of bias and hallucinations, and lack of resources, in fact, are just some of the challenges that need to be faced in order to safely and effectively apply LLMs in specific clinical contexts [1].

To solve some of these issues, at least partially, in the last year Small Language Models (SLMs) are gradually becoming a common solution. SLMs are lightweight AI models designed to perform language tasks with fewer parameters (under 20B) and computational requirements than LLMs. Their main advantages include faster inference, lower hardware costs, and easier deployment on local or edge devices, making them more accessible and privacy-friendly. In medical practice, SLMs can be used for the same tasks of LLMs, such as clinical note summarization, decision support, and on-device data processing, where their smaller size supports secure, efficient, and privacy-preserving applications within healthcare settings [2].

In this paper, we present an application of a local IT5 model finetuned for the automated interpretation of clinical text notes, written in Italian, of patients suffering from Autoimmune Atrophic Gastritis (AAG), using an Italian multicentric dataset. Model performance is evaluated against reference annotations, provided by clinicians within the study team, for the extraction of endoscopic markers organized into structured categories. We show that the proposed model outperforms two bigger models in the same task, demonstrating the validity of SLMs in specific clinical settings where resources might be limited.

2. Related Work

Recent research has explored the use of SLMs in clinical contexts, demonstrating their potential for efficient and privacy-preserving applications. For example, MedS^3 [3] introduced a reasoning-enhanced SLM capable of outperforming larger models on medical question-answering tasks through self-evolved reasoning strategies. Other studies, such as evaluations of phi-3-mini and lightweight transformer variants for clinical note classification [4,5], have shown that compact models can maintain competitive accuracy when finetuned on domain-specific data. Collectively, these works indicate that SLMs offer a promising balance between efficiency, data security, and task performance in clinical language processing.

However, despite these advances, SLMs still face limitations in handling complex reasoning, rare clinical cases, and multilingual data, and their reliability and safety must be carefully evaluated before deployment in medical settings.

In a recent study regarding an Italian clinical setting, a monolingual Italian Text-to-Text Transfer Transformer (IT5) was finetuned for clinical information extraction and restructuring of free-text radiology notes [6], showing competitive performance for structured-reporting. IT5 promises to be a practical choice for Italian clinical natural language processing (cNLP) when properly adapted and evaluated.

In this work, we present a new application of this model, finetuned for a new clinical setting, and compare its performances with other models.

3. Dataset and Methods

The following sections describe the AAG dataset, the clinical notes, and the models employed in our evaluation framework.

3.1. Dataset

425 clinical notes were extracted from a multicentric Italian dataset containing data of 1598 patients suffering from Autoimmune Atrophic Gastritis (AAG), an autoimmune condition characterized by the gradual destruction of the gastric parietal cells, that can lead to significant functional impairments and severe complications such as gastric cancer. Data were collected from nine different centers between the years 1968 and 2023, and structured into two different parts: one containing cross-sectional clinical data at the time of diagnosis (demographic variables, patients' behavior, familiarity, risk factors, autoimmune comorbidities and symptoms); and one containing the results of a series of esophagogastroduodenoscopies (EGDSs) where each patient was evaluated through direct observation of the gastric mucosa and through histological examination of the stomach corpus to assess the level of atrophy. Each patient underwent up to four different EGDSs distanced by irregular time intervals. For each EGDS, the results are reported in a clinical note written in natural text in Italian language.

3.2. Feature Annotation

From the clinical text notes, 13 endoscopic markers (features) were created and annotated by a team of physicians at the San Matteo Polyclinic Hospital in Pavia, Italy: 12 binary features representing the presence or absence of specific conditions (i.e., atrophy, hypotrophy, and hyperemia of the antrum, corpus, and fundus; hiatal hernia; neuroendocrine tumor–NET; carcinoma), and one multi-class feature describing polyps (categorized as absent, isolated of small size, isolated of large size, multiple, or multiple of small size). The dataset is generally characterized by class imbalance, with a prevalence of the "present" condition of less than 30% across all annotated features. To address the most severe cases of imbalance, three features (hiatal hernia, NET, and carcinoma) present in less than 5% of the notes were excluded. In addition, polyps feature classes were aggregated into a ternary classification (absent, isolated, and multiple). As a result, a final set of 10 features was used in the study.

3.3. Methods

To address the task of this study, we adopted a strategy focused on SLMs. The brevity of the clinical notes, within the 512-token limit, made the encoder-decoder Italian-pretrained T5 models [7] a suitable primary candidate. We finetuned the IT5-Base model (220M of parameters), hereafter referred to as IT5, to serve as our task-specific model. The dataset was split into training, validation, and test sets in a 70:15:15 ratio. IT5 finetuning was performed using the training and validation sets, respectively of 297 and 64 notes, framing the feature extraction as a question-answering task. In this setup, each feature was formulated as a unique, standardized natural language question[2] to which the model would generate a textual answer within the predefined options.

To assess IT5's performance, we compared it against two other models:

a. GPT-4o mini [8]: a cost-effective, widely-used small model from OpenAI, chosen to represent a general-purpose SLM with strong capabilities despite its reduced scale (estimated at tens of billions of parameters).

[2] Prompt example (translated from Italian): *"Diffuse hypotrophy, diffuse chronic inflammation. Options: 1) no 2) yes. Question: Does hyperemia affect the gastric antrum?"*

b. MedGemma (4B) [9,10]: a variant of the Gemma 3 model pre-trained on medical data, chosen to represent a domain-specialized SLM with competitive performance on medical benchmarks.

This comparative framework is designed to assess the competitiveness of IT5 against both a popular general-purpose (a) and a medically-oriented SLM (b). For consistency, all models were evaluated using text-only prompts, despite the multimodal capabilities of GPT-4o mini and MedGemma, on the test set of 64 notes. Evaluation metrics included strict accuracy (defined as the exact match between the model's generated answer and the reference annotation), as well as sensitivity, specificity, precision, F-score, and balanced accuracy.

4. Results

Table 1 reports the results obtained from the evaluation. IT5 demonstrated the highest strict accuracy among all models, slightly outperforming the closely competing GPT-4o mini. Furthermore, IT5 achieved the best sensitivity, indicating a superior ability in correctly identifying the presence of a condition. This high sensitivity is a particularly valuable characteristic, given the general class imbalance in the dataset where the "present" condition was a minority across all features. This performance came at the cost of a slightly lower specificity compared to the other models, although remaining high. Notably, IT5 also achieved the top scores in both F-score and balanced accuracy. This overall superiority across the metrics suggests that IT5 offers the most robust and reliable performance for this task, effectively balancing the trade-off between identifying true positives (sensitivity) and minimizing false positives (specificity), which is crucial for rare diseases.

Table 1 Overall results of the evaluation. For each metric, the best result is highlighted in bold.

Model	Strict accuracy	Sensitivity	Specificity	Precision	F-score	Balanced accuracy
IT5	**90.16**	**87.40**	91.19	71.15	**78.44**	**89.30**
GPT-4o mini	89.06	78.04	92.76	**72.89**	75.38	85.40
MedGemma	78.59	64.14	**93.42**	71.22	67.49	78.78

The error analysis, illustrated in Figure 1, reveals that the three models often make similar types of errors. These clinical notes are subtle and could be challenging to classify, even for a human annotator.

Clinical note	Feature	Reference	IT5	gpt-4o mini	MedGemma
Diffuse hypotrophy, diffuse chronic inflammation.	hyperemia antrum	yes	no	no	no
	hyperemia fundus	yes	no	no	no
	hyperemia corpus	yes	no	no	no
Erosive striae on the greater curvature.	hyperemia corpus	yes	no	no	no
Hypotrophy, antral striae.	hyperemia antrum	yes	no	no	no
In antrum: linear and micronodular hyperplasia of enterochromaffin cells. In corpus-fundus: quiescent chronic gastritis.	hyperemia fundus	yes	no	no	no
	hyperemia corpus	yes	no	no	no

Figure 1 Common errors. Examples from the error analysis illustrating incorrect predictions on clinically subtle notes. Columns report the reference annotation and each model's prediction for the target feature.

5. Discussion and Conclusion

This study demonstrates the viability of SLMs for clinical information extraction in a real-world multicentric context, highlighting their potential to emulate physicians' annotations in an efficient and high-performant way.

A key finding is the competitiveness of the finetuned IT5 model, which performed comparably to GPT-4o mini on this specific task. Its local implementation offers significant privacy advantages, and its high sensitivity is particularly well-suited to a rare clinical context. The underperformance of the medical-oriented MedGemma, despite its broader medical knowledge, suggests that task-specific finetuning was more critical for accurate condition recognition than general medical pretraining.

We recognize that this work has several limitations: e.g. the findings are strongly tied to the Italian language and the specific information extraction task, which may limit their applicability to other linguistic and broader clinical domains; plus the evaluation involved a limited selection of SLMs and the comparison with MedGemma may not be completely fair, as its base version was used without task-specific finetuning, unlike IT5.

This study, however, lays the groundwork for future research, including finetuning MedGemma and improving IT5's performance on edge cases. In addition, we are working with our clinical partners to conduct an in-depth qualitative analysis to understand the clinical implications of extraction errors, which is crucial for assessing real-world utility and safety.

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