Development of an Electronic Medical Record Screening System Using Large Language Models to Prevent Missed Vertebral Fractures Associated with Traffic Accidents

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Abstract
Recent changes in working regulations for physicians have increased the likelihood that less-experienced doctors provide initial care in emergency departments, raising concerns about variability in clinical evaluation and missed diagnoses. Missed vertebral fractures can lead to neurological deficits and long-term functional impairment. This study aimed to develop an automated screening approach based on free-text entries in electronic medical records to minimize missed vertebral fractures. We analyzed 334 patients who were presented with low back pain, back pain, or lumbar contusion between 2013 and 2023 and subsequently underwent MRI to confirm the presence or absence of compression fractures. Text from the subjective and objective sections of the records was processed and evaluated using two locally implemented large language models (LLMs), Japanese-capable large language models and medically specialized large language models, with both simple and detailed prompts. The detailed prompts resulted in higher sensitivity (Both are in the 0.8 range) and improved AUROC values compared with simple prompts. In addition, vertebral fracture–related factors extracted by the LLMs were used to train Light GBM models, which achieved sensitivities of approximately 0.8 and AUROC values of approximately 0.7. These findings suggest that an automated screening system based on routine clinical documentation may help reduce missed vertebral fractures in emergency care. The combination of LLM-based factor extraction and machine learning offers both high sensitivity and improved transparency in the decision-making process.