

MEDIA RELEASE

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NUH TEAM INVENTS AI TOOL TO ACCELERATE DIAGNOSIS OF LUMBAR SPINAL STENOSIS

Spine AI significantly cuts more than half the time it takes for radiologists to interpret MRI scans, study shows

SINGAPORE — Lumbar spinal stenosis is a narrowing of the spinal canal in the lower back, leading to compression of the nerves supplying the lower limbs. Patients typically present with cramps and pain in the buttocks or legs while walking, which are relieved by sitting or bending forward.

About one in 10 people in the general population¹ are affected by lumbar spinal stenosis, which relies on a lumbar MRI scan as the most important tool for diagnosis.

In a significant advancement for medical diagnostics, an in-house artificial intelligence (AI) deep learning system which more than halves the time it takes for a radiologist to interpret an MRI scan is now being used at the National University Hospital (NUH).

Since June, Spine AI has been trialled in more than 50 patients. The deep learning tool automatically detects the area where narrowing of the spinal canal occurs, as well as categorises the severity of stenosis, providing rapid results that enhance clinical decision-making and efficiency.

Developed in-house by NUH in collaboration with a team from the National University of Singapore's School of Computing (NUS Computing) and the National University Spine Institute, Spine AI was trained using lumbar spine MRI studies from 446 patients, encompassing more than 18,000 images.

Traditionally, after a patient has undergone an MRI scan, a radiologist will manually assess the severity of stenosis at every level along the lumbar spine. With five spinal segments that each have five potential sites for stenosis, this means the radiologist has to analyse 25 regions in a patient's spine before writing up a report, a process that can take 10 minutes or more.

Dr Andrew Makmur, Group Chief Technology Officer, National University Health System (NUHS), and Consultant, Department of Diagnostic Imaging, NUH, said: "The degree of stenosis, or narrowing, at each region plays a role in determining the appropriate treatment, but detailing such information in a report can be repetitive and time-consuming. In addition, there are multiple grading systems for lumbar spinal stenosis, with a lack of standardisation."

¹ Lurie J, Tomkins-Lane C. BMJ. Management of lumbar spinal stenosis. 2016 Jan 4;352:h6234.

Dr Makmur and Dr James Hallinan, Senior Consultant, Department of Diagnostic Imaging, NUH, spearheaded the development of Spine AI, which improves the consistency, accuracy and objectivity of MRI scan assessment.

Dr Hallinan explained: “The model will automatically detect the sites of stenosis and then grade the severity, before automatically generating a report. Colour-coded boxes will then be placed along every site in the lumbar spine to enable the radiologist to quickly inspect the gradings. This streamlined process can reduce the time for interpretation of a scan from 10 minutes to just 3 minutes.”

In a study² published in the medical journal *Radiology* in 2022, it showed that radiologists who used Spine AI took as short as 47 seconds to interpret each spine MRI study, compared with up to 4½ minutes when they did not use the model.

This time-saving advantage was observed across all experience levels, with in-training radiologists having the largest mean time saving of 74 per cent when using Spine AI.

Dr Makmur estimated that with about 4,000 lumbar MRI scans done in NUH each year, and approximately 7 minutes saved per MRI scan, this translates to about 466 hours saved a year.

He said: “AI is transforming spinal imaging and patient care through automated analysis and enhanced decision-making. With Singapore’s ageing population and an expected increase in imaging volume, there is great potential for Spine AI to augment radiologists’ efficiency and allow them to focus on more complex cases.”

Dr Jonathan Tan, Consultant, University Spine Centre, Department of Orthopaedic Surgery, NUH, said: “Lumbar spinal stenosis can lead to a significant loss of mobility and quality of life. It is the most common indication for spinal surgery in patients aged 65 and above. Spine AI can potentially contribute to the efficient diagnosis and classification of this common condition to enable prompt and appropriate interventions.

“While AI can accurately identify areas of spinal stenosis, the decision to treat is based primarily on the patient’s symptoms and a doctor’s clinical judgement, as not all individuals with spinal stenosis experience discomfort or physical limitations,” he added.

Professor Ooi Beng Chin from the Department of Computer Science at NUS Computing said: “To develop Spine AI, we had to ensure accurate anatomical modelling of the spine and consistent performance in detecting abnormalities in diverse patient populations. Efficient data labelling was crucial in this aspect.”

In November 2023, NUH partnered Germany-based medical technology company Siemens Healthineers to optimise the user interface/user experience (UI/UX) of Spine AI. This collaboration aims to bring the AI tool to a global market, where it could have a transformational impact on spinal care worldwide.

“Siemens Healthineers is proud to be partnering with the NUHS team on the Spine AI project, integrating the AI solution into its clinical workflow. This has a significant impact

² DSW Lim, et al. *Radiology*. Improved Productivity Using Deep Learning-assisted Reporting for Lumbar Spine MRI. 2022 Oct;305(1):160-166.

on both clinicians and patients,” said Ms Siow Ai Li, Managing Director of Siemens Healthineers Singapore and Malaysia.

“It is wonderful to see how this AI solution is now accessible throughout the NUHS radiology department for clinical evaluation. With the success of this collaboration, we are confident that Spine AI will enable radiologists to quickly identify abnormalities in a large volume of scans, improving efficiency and reducing the burden of repetitive tasks through automation.

“This project clearly demonstrates Singapore’s commitment and ability to build clinical AI solutions, and we are very proud to be able to leverage the integration capabilities of Siemens Healthineers’ existing digital solutions within the radiology infrastructure to deploy the Spine AI model smoothly. We hope that this approach will serve as a template for further adoption and integration of AI solutions in clinical environments, ultimately benefiting patients by enabling faster diagnosis and treatment,” she added.

Patient profile

Madam Elsie Ling, 84, was diagnosed with lumbar spinal stenosis at the National University Hospital (NUH) in 2021. She suffered from back, buttock and lower limb pain, which worsened on walking and standing. She was prescribed medication and put through physiotherapy. Due to her advanced age and the potential risks of surgery, she was not keen to undergo surgery.

To relieve her pain, she had a transforaminal epidural steroid injection, which is an injection of corticosteroids (anti-inflammatory medication) into the epidural space where the nerve exits the spine.

In July last year, the former midwife sustained a fall which worsened her condition. At one point, she relied on oral painkillers so she could be pain-free for a few hours to attend church twice a week, but she was unable to travel overseas to visit her daughter-in-law. Two further rounds of steroid injections did little to help her. By May this year, Madam Ling found herself housebound, unable to attend church nor go out to buy groceries.

She said: “My legs were very sore, it felt like somebody had twisted them.”

By July this year, her symptoms had become unbearable and she decided it was time to undergo surgery. Before surgery, Dr Jonathan Tan, Consultant, University Spine Centre, Department of Orthopaedic Surgery, NUH, ordered an MRI of her lumbar spine, which was then analysed by Spine AI.

Spine AI identified and classified the area of most severe narrowing in her L4L5 spinal segment, which consists of the two lowest vertebrae in the lumbar spine. Fortunately, it also showed that there were no new areas of severe stenosis.

Through MRI and EOS full-body imaging, she was also found to have spondylolisthesis, or forward slippage of one vertebra on the other in her L4L5 spinal segment. These findings were further confirmed by the treating radiologist and surgeon and helped the surgical team to make the decision to treat only this segment of her spine.

On 17 July, Madam Ling underwent surgery to relieve the compression on the nerves in her lower spine and fuse (surgically join) the L4L5 vertebrae to treat her spinal stenosis. Since then, her pain has reduced significantly, and she is currently undergoing physiotherapy to improve her mobility.

Chinese Glossary

National University Health System (NUHS)	国立大学医学组织 (国大医学组织)
National University Spine Institute (NUSI)	国立大学脊椎中心 (国大脊椎中心)
National University Hospital (NUH)	国立大学医院 (国大医院)
Dr Andrew Makmur Group Chief Technology Officer National University Health System Consultant Department of Diagnostic Imaging National University Hospital	伍帅润医生 集团首席技术官 国立大学医学组织 顾问医生 影像诊断科 国立大学医院
Dr James Hallinan Senior Consultant Department of Diagnostic Imaging National University Hospital	詹姆士哈利南医生 高级顾问医生 影像诊断科 国立大学医院
Dr Jonathan Tan Consultant University Spine Centre Department of Orthopaedic Surgery National University Hospital	陈炯豪医生 顾问医生 国大脊椎中心 骨科外科部门 国立大学医院
Professor Ooi Beng Chin Lee Kong Chian Centennial Professor Department of Computer Science School of Computing National University of Singapore	黄铭钧教授 李光前百年纪念讲席教授 计算机科学系 计算机学院 新加坡国立大学
Ms Siow Ai Li Managing Director, Singapore and Malaysia Siemens Healthineers	蕭愛莉 新加坡及马来西亚董事长 西门子医疗

For media enquiries, please contact:

Joan CHEW
Group Communications
National University Health System
Email: joan_chew@nuhs.edu.sg

About the National University Hospital (NUH)

The National University Hospital (NUH) is Singapore's leading university hospital. While the hospital at Kent Ridge first received its patients on 24 June 1985, our legacy started from 1905, the date of the founding of what is today the NUS Yong Loo Lin School of Medicine. NUH is the principal teaching hospital of the medical school.

Our unique identity as a university hospital is a key attraction for healthcare professionals who aspire to do more than practise tertiary medical care. We offer an environment where research and teaching are an integral part of medicine, and continue to shape medicine and transform care for the community we care for.

We are an academic medical centre with over 1,200 beds, serving more than one million patients a year with over 50 medical, surgical and dental specialties. NUH is the only public and not-for-profit hospital in Singapore to provide trusted care for adults, women and children under one roof, including the only paediatric kidney and liver transplant programme in the country.

The NUH is a key member of the National University Health System (NUHS), one of three public healthcare clusters in Singapore.