



# University Hospital Zurich automates medical coding with machine learning

Client name: University Hospital Zurich

Location: Zurich, Switzerland

Industry: Healthcare

### Challenge

- Help University Hospital Zurich take a semiautomated approach to medical coding, replacing a manual, complex and time-consuming process

### Solution

- Created a machine learning system that accurately proposes complex medical codes to human administrators

### Results

- Optimized revenues in a coding revision by identifying additional medical codes
- Significantly reduced coding errors
- Increased ability of human coders to focus on complex cases
- Accelerated generation of bills — and payments

## Physicians, administrators and other healthcare professionals at University Hospital Zurich (USZ) will have a new assistant in the future: a machine learning system that helps them assign super-accurate medical codes.

For USZ, one of Switzerland's largest healthcare providers, accurate medical coding is vital. Each time a patient visits the hospital, the patient's record must be updated with codes for relevant factors, including the patient's complaints / diagnoses or medical procedures. These codes, in turn, are used for invoicing and insurance reimbursements.

Fortunately, these medical codes follow standards. For diagnoses, the main coding system is the ICD-10, short for International Statistical Classification of Diseases and Related Health Problems, 10th Revision. It's published by the World Health Organization, used in 117 countries and available in 43 languages.

Even with standards, medical coding is complicated. The ICD-10 catalog alone offers some 15,000 diagnosis codes. Other coding systems are used too, mainly for classifying treatments. It adds up quickly. The average hospital patient receives eight diagnoses per visit — and up to as many as 100. Every diagnosis and procedure must receive its correct code, both for record-keeping and billing. Most coding is done manually, and any errors can be time-consuming and costly. "We don't get paid for errors," says Dr. Rudolf Moos, a physician who is USZ's head of data management. "The coding quality has to be very high."

Although the work of USZ's coding team is quite accurate, errors do slip through. With more than 40,000 inpatient visits a year, even a small number of errors can be costly. USZ administrators estimated that coding errors were costing the hospital more than 1 million Swiss francs (approximately \$1.1 million) every year, even though the quality of the medical coding was proven to be very high. Improvements in efficiency and quality were highly welcome.

### Software that learns

One solution might have been to enlist more human coding specialists. But these workers are rare, highly specialized and expensive. Instead, USZ worked with DXC Technology to create a novel alternative: a semiautomated coding system that uses machine learning. The vision is to have a system at the end which works with human coders, proposing ICD-10 codes that the coders verify or correct, then use them to generate state-of-the-art invoices.

This semiautomated solution aims to drastically reduce the human effort involved in medical coding, freeing the coding team to spend more time on the most complex situations. Also, physicians can continue to write documentation and codes in their own style, rather than having to adhere strictly to the ICD-10 standard. The machine learning system takes their work and adjusts it to the standard.

Other healthcare organizations have wrestled with medical coding, and they've tried other approaches. One involves using rules-based systems. But these systems have been hampered by the sheer number of medical codes, each needing its own rule. Also, rules-based systems struggle with unstructured data and the great number of possible acronyms, which is precisely the kind of data many medical reports contain.

To create their machine learning solution, USZ and DXC created a prototype solution able to handle codes for 128 diagnoses. While early results were encouraging, the system slowed as the model was extended to cover 256 diagnoses. This challenge arose because a patient can have every combination of diagnoses — a situation known as multilabel classification. To improve the speed, a second system was developed. Using a different programming language and a more distributed computing architecture, it could also identify codes for the hospital's top 1,000 diagnoses by frequency. Results from this new system were striking. Tasks that had taken hours in the earlier prototype were now being completed in minutes.

### Getting smarter

Still, more work remains. The machine learning solution has indeed learned, and it can currently generate some 2,000 codes. The goal for the next year is to increase that to 4,000 codes, along with a 99 percent rating for both diagnosis specificity and accuracy. "Eliminating errors is important," explains Michael Gehbauer, a DXC sales executive for analytics, "because a machine learning system will learn even the mistakes."

To improve its accuracy, the machine learning system will be fed additional documentation and information, including information on a patient's age, gender, duration of stay, operations and procedures, medications and lab results. Fortunately, USZ has been using electronic medical records since the early 1990s, so its database offers a rich resource. "We'll use this historical data to train the system," Dr. Moos says.

Looking ahead, DXC and the USZ team hope to integrate their machine learning solution, now being used by a single hospital division, into the hospital's main information system. An opportunity for the future could be to extend the system to use it not only for coding purposes, but also to help answer other important questions, such as: Does the patient get the optimal medication?

Billing applications will be expanded, too. Currently, the machine learning system is used mainly to correct older bills. Under Swiss law, hospitals can resubmit bills up to 5 years old. Going forward, the system will be used to code new bills semiautomatically.

"We have a lot of IT experts on staff, but we needed a partner for big data solutions and machine learning approaches. What we're doing here has not been accomplished anywhere else. We're glad we found such a partner."

— Dr. Rudolf Moos,  
Head of Data Management  
University Hospital Zurich

For USZ, working with DXC has been vital to success. “We have a lot of IT experts on staff, but we needed a partner for big data solutions and machine learning approaches,” Dr. Moos says. “What we’re doing here has not been accomplished anywhere else. We’re glad we found such a partner.”

**Learn more at  
[www.dxc.technology/  
analytics](http://www.dxc.technology/analytics)  
and  
[www.dxc.technology/  
healthcare](http://www.dxc.technology/healthcare)**

**About DXC Technology**

DXC Technology (DXC: NYSE) is the world’s leading independent, end-to-end IT services company, serving nearly 6,000 private and public-sector clients from a diverse array of industries across 70 countries. The company’s technology independence, global talent and extensive partner network deliver transformative digital offerings and solutions that help clients harness the power of innovation to thrive on change. DXC Technology is recognized among the best corporate citizens globally. For more information, visit [www.dxc.technology](http://www.dxc.technology).