

# ClinCode - Computer-Assisted Clinical ICD-10 Coding for improving efficiency and quality in healthcare



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## Introduction

Manual ICD-10 diagnosis coding is time consuming and error prone (up to 20-30 percent errors) according to studies in Sweden and Norway. Lots of unstructured data is stored digitally in large Electronic Patient Records systems. Simultaneously, Natural Language Processing and Artificial Intelligence methods have shown their efficiency in various text processing tasks, such as text classification, topic modelling, machine translation, text summarisation and others. These factors combined have made it possible to create a Computer-Assisted Clinical Coding (CAC) tool for ICD-10 codes that suggest codes to the discharge summary.

However, several challenges still exist, especially for minor languages like Swedish and Norwegian, primarily driven by inaccessibility of clinical data for training data-driven algorithms. Deep learning methods using large language models are investigated as potentially useful tools for training CAC models. The objective of the current study was to document the feasibility of predicting ICD-10 blocks from Swedish discharge summaries, towards a future pipeline designed to predict the full code.

## Methods

The data contains 6,062 Swedish discharge summaries from 4,985 unique patients with 263 unique ICD-10 codes in the Gastro surgery medical specialty. The data is divided into ten logical blocks: K00-K14, K20-K31 up to K90-K93.

Din mag- och tarmrelaterade journalanteckning

En 82-årig trombylbehandlad man inkommer akut med magsmärter och ett förmodat lågt Hb. Genomgår 3/3 gastroskopi som visar dels en svårartad esofagit men även ett duodenalulcus. Mår emellertid bra. Ny kontroll av Hb visar cirka 110, mobiliseras, får äta och går hem med recept på trippelbehandling, fortsätter med Omeprazol minst en månad. Inget planerat återbesök.

Föreslå ICD-10 koder

Föreslagna ICD-10 koder:  
K20-K31 (Matstrupens, magsäckens och tolvfingertarmens sjukdomar)

Visualiserade attention weights – ju rödare desto högre vikt:  
en 82-årig trombylbehandlad man inkommer akut med magsmärter och ett förmodat lågt Hb. genomgår 3 / 3 gastroskopi som visar dels en svarar tads of ag it men även ett duodena lu ic us . mår emellertid bra . ny kontroll av hb visar cirka 110 . mobiliseras , får äta och går hem med recept på trippel behandling . fortsätter med omeprazol minst en man ad . inget planerat återbesök .

Fig 1. The web-based ICD-10 coder.

The data have been used to fine tune a clinical language deep learning BERT model called SweClin-BERT encompassing two million patients.

To obtain better training data for ICD-10 coding a set of Norwegian 4,799 discharge summaries have been re-coded with the correct ICD-10 codes. This data set will also be used to predict ICD-10 codes.

## Results

The results show an  $F_1$ -score of 0.835 for the prediction of ICD-10 at 10 block level using the clinical language model SweClin-BERT (Lamproudís et al. 2022). A web-based demo called ICD-10 coder<sup>1</sup> has been created to demonstrate the code assignment. see Figure 1. However, that model is based on KB-BERT a general Swedish Language model that does not contain sensitive personal information, (Remmer et al. 2021).

Current coding practice is error prone. An analysis of all discharge summaries from a Norwegian Gastro Clinic over the course of 3 years (3,554 patients) showed an Inter Annotator Agreement in Kappa value of 0.66 for the whole code-line and 0.7 for the main diagnosis isolated. Kappa values are not directly translated to percentages, but the results correspond to a moderate agreement where 35-63% of the data are reliable. A large portion of errors came from misregistration of complications.

## Conclusions

It is shown that automatic assignment of ICD-10 codes is feasible using machine learning and creates plausible results at least at 10 block level. Prediction at the block-level was an important preliminary step in the project. Experiments are continuing, using recent advances in deep learning and fuzzy logic, to improve results and specifically in predicting unique full codes, as well as developing the mechanism for explaining which words in the discharge summary give the highest weight for the prediction of a specific ICD-10 code.

## References

Remmer, S., Lamproudís, A. and H Dalianis. 2021. Multi-label Diagnosis Classification of Swedish Discharge Summaries – ICD-10 Code Assignment Using KB-BERT. In the Proceedings of RANLP 2021: Recent Advances in Natural Language Processing, 1-3 Sept 2021, Varna, Bulgaria,

Lamproudís, A., Henriksson, A. and H. Dalianis. 2022. Vocabulary Modifications for Domain-adaptive Pretraining of Clinical Language Models. In Proceedings of the 15th International Joint Conference on Biomedical Engineering Systems and Technologies – Volume 5: HEALTHINF, pp. 180-188

<sup>1</sup><https://icdcoder.dsv.su.se>