reaction is recorded this functionality is not provided which results in increased risk to the patient.

The aim of this project was to identify recurring free text reactions and incorporate these into the system. Future avoidance of free text documentation will improve data quality and make reaction data available during built-in prescribing decision support.

Methods Free-text allergy notes added to the electronic prescribing system since implementation in March 2018 were extracted using structured query language. The data was cleaned and analysed using the Python.

Natural language processing techniques were employed to clean the data and reduce the dimensionality of the data set. A drug library extracted from the electronic prescribing system was used to tag medications within the text.

After pre-processing the most commonly occurring phrases were found by counting the most frequent bigrams present in the text. Further analysis was carried out using the apriori algorithm.

Results A total of 2872 notes were identified for analysis. The most common terms found were already included as part of the electronic prescribing systems allergy documentation system. This included the terms 'rash' and 'penicillin' which were recorded 480 and 400 times respectively. Of the top 20 most frequently appearing terms two were identified as not included in the system. These were 'swelling' which was recorded 320 times and 'pain' documented 210.

Applying a Bi-gram and filter identified that the term swelling was most often associated with the phrase 'ankle swelling' which appeared 60 times. The apriori algorithm identified an association between the terms ankle and swelling and amlodipine with high levels of confidence.

Pain was most often associated with the phrases 'chest pain' appearing 38 times and 'abdominal pain' or 'abdo pain' appearing a combined 55 times. Both are reaction types which cannot be documented in the prescribing system without the addition of a free-text note.

Conclusion Natural Language Processing can be applied to large sections of unstructured clinical documentation to quickly analyse themes and trends. With appropriate cleaning and manipulation of the data commonly occurring phrases relevant to clinical practice can be identified.

This permitted recurring drug reactions to be identified and added to the electronic prescribing system. It is hoped this will reduce the frequency of free-text notes added in the future and improve reaction documentation. It is anticipated that patient safety will be improved by making more reaction data available for electronic decision support.

Packages such as Python NLTK used for natural language processing are freely available and allow users to process data which would be too time consuming to process manually.

10 DEVELOPMENT AND EVALUATION OF A MACHINE LEARNING MODEL TO PREDICT POSITIVE URINE CULTURES IN THE OUTPATIENT SETTING AND MINIMIZE THE USE OF ANTIBIOTICS

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10.1136/bmjhci-2022-FCIASC.10

Objective Excessive prescription of antibiotics is amongst the principal drivers of antibiotic resistance, which is considered a surging threat to global health. The most frequent resistant pathogens are usually linked with urinary tract diseases, such as urinary tract infections (UTI). Studies have shown that clinicians may prescribe antibiotics based on presenting symptoms due to the prolonged time required to obtain the final results of urine bacterial cultures. While many of the current approaches to ameliorate prescribing behavior are educational or regulatory, here we develop and evaluate a logistic regression model that detects the risk of positive urine cultures based on the patient's history and presenting physiological data extracted from the electronic health records, to help clinicians make informed antibiotic prescription decisions without the need to wait for urine culture results.

Methods We used an anonymized dataset collected between 2015 and 2021 in a multi-specialty large hospital with primary, secondary and tertiary care facilities. The retrospective study received approval by the Institutional Review Board (IRB) from both the research institution and hospital (IRB references: HRPP-2020-173 & A-2019-054, respectively). We included adult outpatient encounters associated with at least one urine culture test. For the input features, we extracted and pre-processed each patient's demographics (age, sex), comorbidities (diabetes millutus, hypertension, cancer and hyperlididemia), vital signs (pulse, respiratory rate, oxygen saturation, temperature, systolic blood pressure, diastolic blood pressure and fraction of inspired oxygen), instant urine dipstick test results, all collected prior to the acquisition of the urine culture, as well as diagnosis codes (ICD-10 codes) and procedure codes (hospital custom codes) from the patient's previous hospital encounter. We defined the output as a binary label indicating a positive or negative urine culture result by processing textual data within laboratory test results. We assume a positive urine culture if the concentration of urine pathogen is higher than 100,000 colony forming units per milliliter (CFU/ml). We split the dataset randomly into a training (70%), and test set (30%). We optimized a logistic regression model using the training set with stratified k-fold validation, and evaluated it on the test set with 95% confidence intervals computed using bootstrapping with 1000 iterations.

Results After applying the inclusion criteria, the overall dataset consisted of 11,388 patients with 17,452 unique encounters (56.1% females; mean age 49.1 standard deviation 17.5 years). Amongst all encounters, 2,431 (13.9%) were associated with a positive label. We evaluated the models on the held-out test set consisting of 5,236 encounters (14.2% of encounters had positive urine culture). The logistic regression model achieved a 0.851 (0.837, 0.865 95% CI) Area Under the

Receiver Operating characteristic Curve (AUROC) and 0.584 (0.546, 0.618 95% CI) Area Under the Precision Recall Curve (AUPRC). Amongst the female population, the logistic regression model achieved a 0.806 AUROC compared to a 0.905 AUROC amongst males. When investigating different patient age groups, the model achieved a 0.84 AUROC amongst patients younger than 40 years, compared to 0.848 AUROC amongst patients who are 40 years or older.

We binarized the predictions by adjusting the threshold to achieve approximately 80% sensitivity on the test set, which is a clinically acceptable level of sensitivity. Amongst the 4,460 encounters associated with a negative urine culture in

the test set, 351 were prescribed with a UTI-related antibiotic during their respective encounters. With the fixed threshold, our model was able to correctly classify 59.0% (207/351) as negative amongst those who did not require an antibiotic.

Conclusions In this study, we develop and evaluate a machine learning model for predicting positive urine cultures which is associated with UTI amongst outpatients using a real-world dataset. Our results demonstrate that the optimized model has the potential to decrease false positives and as a result minimize unnecessary antibiotic prescription. In future work, we are interested in further improving the model by leveraging temporal sequences of the input features, extensively fine-tuning hyperparameters of the model, and decreasing the performance gap across different patient subgroups. While our study uses a dataset collected in a single cohort, the results can be translated into other settings via external validation or by simply fine-tuning the model. Overall, our novel application is of high relevance to the clinical informatics community considering the global threat of antibiotic resistance, especially in the context of managing urinary tract infections.

11 WOUBOT AND TRUST4HEALTH; PREDICTIVE PERSONALISED AI TOOLS FOR FRONT LINE CLINICIANS

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10.1136/bmjhci-2022-FCIASC.11

Objective Integrating technological innovation in clinical big data from Nine Health Global (NHG) and data science Woubot is a prototype precognitive system for community & wound clinics. Focusing on leg ulcers, Woubot will produce recommendations from several thousand possible treatment combinations. Working with suppliers to the National Wound Care Strategy Programme, the project will create a suite of automated software tools with a user-friendly mobile application designed by doctors and nurses for their own use within the NHS. This will generate a personalised care pathway for each patient via a series of recommendations. TRUST4Health will apply the technology to other diseases.

Methods We undertook a feasibility study to test artificially intelligent software on data from Cegedim Thin and the NHS Community Data set. We combined know how from our A.I. diagnostic system Diagbot co-produced with a Chinese partner for grass roots doctors in China and applied data science techniques creating a new AI prototype system. With a consortium led by the Royal College of Surgeons in Ireland (RCSI) we have applied for Horizon 2022 EU government funding to build on the work in wounds and to apply the methods to 3 other vascular clinical diseases stroke, heart failure and dementia . Woubot will use artificial intelligence (AI) to identify people likely to develop chronic leg wounds and manage their preventative care. In those that already have leg wounds, such as diabetic foot ulcers, the software will help to ensure that evidence of effective treatment is turned into simple steps which are available quickly and easily to front-line staff. Our AI software will rapidly sift through millions of data items in secure NHS facilities. This will enable recommendations to be generated via a mobile app. A suite of software tools will generate a personalised care pathway with a series of recommendations for use in the NHS. Most of this care will be delivered by nurses and other healthcare professionals in clinics and the community. Prescriptions, whether for exercise, other lifestyle changes, medication or dressings, will be individualised for each patient based on their history and biological makeup and linked to the latest clinical evidence. We will also use image software to monitor progress easily and accurately.

Results We built a secure platform hosted by UK Cloud (Nine Health Community Interest Company is an NHS research data organisation)using wound data sourced from Cegedim Thin and the NHS Community Data set (NHS Humber Foundation Teaching Trust) using patient pseudonymised data sources (which have gone through the double de-identification process). Data was reviewed by a statistical expert to exclude bias and included a national sample from primary care and a local sample from Hull and East Riding where the demographic includes both inner city, city and rural and a diverse range of nationalities including black, ethnic and minority groups aged 19–80. We collated and analysed around 2000 comprehensive patient records of those with hard to heal wounds (diabetic foot ulcer and venous leg ulcer) across a 2-year period. A raft of modifiable predictive factors such as Vitamin B12 levels, the impact of BMI on healing were identified and analysed. Isolating the key measures enabled the prediction of time from developing diabetes to developing a foot ulcer and then the ability to predict time to an amputation. These results if validated by further research such as the Horizon 2022 EU Trustworthy A.I. project referred to above would enable targeted management to prevent these sequelae. We have developed clinical algorithms based on the national wound guidelines produced by the NWCSP for some parts of the patient pathway

e.g., initial assessment including red flags. We now need to validate via clinical trials and automate processes, combining existing data collected by the National Minimum Wound Assessment Data Set, our data sets and others @ NHS digital https://digital.nhs.uk/ HES, CSDS and other international data.

Conclusion Woubot https://fundingawards.nihr.ac.uk/award/AI_AWARD01723 has started to identify people likely to develop chronic leg wounds and suggested predictive factors which may prevent amputation and death. The automated identification of these factors will in the next phase enable management of their preventative care. In those that already have leg wounds, such as diabetic foot ulcers, the software will help to ensure that evidence of effective treatment is turned into simple steps which are available quickly to front-line staff. Dressing analysis (size and type over time) suggests a good proxy measure for wound healing. In the next phase recommendations for personalised care will be generated via a mobile app. The software will generate a personalised care pathway with a series of recommendations for use in the NHS. Most of this care will be delivered by nurses and other healthcare professionals in clinics and the community.

Prescriptions, whether for exercise, other lifestyle changes, medication or dressings, will be individualised for each patient based on their history and biological makeup and linked to the latest clinical evidence. The clinician chooses whether or not to accept the recommendations and records their decision.

Following the above results in the area of hard to heal wounds we shared these with the Royal College of Surgeons in Northern Ireland and an expert consortium of data scientists and clinicians which has led to our submission to develop trustworthy clinical