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2021
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A Study of HIV Presentations to an Adult Emergency Department and Development and Validation of an Outcome Prediction Model

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A THESIS submitted to the Faculty of Health Sciences, University of the Witwatersrand in fulfilment of the requirements for the degree of Doctor of Philosophy

ABSTRACT

Background: Human immunodeficiency virus (HIV) infection is a global epidemic that has affected approximately 38 million people worldwide. In 2019, HIV ranked as the 3rd highest cause of global mortality. In 2019, there were approximately 1.7 million new cases of HIV with 690 000 HIV related deaths. Sub-Saharan Africa is home to approximately two-thirds of people living with HIV (PLWH). South Africa has an estimated 7.5 million PLWH, which is more than twice that of any other country in the world and equates to approximately one-fifth of the global burden of the disease. It is estimated that 92% of PLWH in South Africa are aware of their status, 70% are on anti-retroviral therapy (ART) and 64% are virally suppressed.

Objectives: This study aimed to 1) describe the patterns of presentation of HIV-positive patients presenting to an emergency department (ED), 2) determine the rates of ART non-adherence and its associations and the reasons for ART non-adherence in these patients, 3) determine the predictors of prolonged hospital length of stay (LOS) in these patients , 4) determine the predictors of in-hospital mortality in these patients, and 5) develop and internally validate a predictive model that will be capable of reasonably predicting in-hospital mortality in HIV-positive patients presenting with an acute illness.

Methods: This was a prospective study that enrolled consecutive HIV-positive patients that presented to the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) adult ED between 07 July 2017 and 18 October 2018. Self-reported adherence was assessed using the AIDS Clinical Trials Group Adherence Questionnaire (ACTG-AQ). Data was also subjected to univariate and multivariate logistic regression to determine parameters associated with a higher likelihood of hospital LOS ≥7 days and a higher likelihood of in-hospital mortality. For the development of the HIV in-hospital mortality prediction (HIV-IMP) model, multivariate logistic

regression was used to determine parameters for inclusion while model discrimination and calibration were assessed by means of the area under the receiver operating curve (AUROC) and the Hosmer–Lemeshow goodness-of-fit test, respectively. Internal validation was conducted using the regular bootstrap technique.

Results: A total of 1224 participants were enrolled in the study. HIV was newly diagnosed in 212 (17.3%), 276 (22.5%) had bacterial pneumonia, 244 (19.9%) had tuberculosis (TB), 86 (7.0%) had gastroenteritis, 205 (16.7%) required intensive care unit admission, CD4 cell count was < 100 cell/mm^3 in 527 (47.6%), HIV viral load (VL) was > 1000 copies/mL in 619 (59.0%), haemoglobin was < 11 g/dL in 636 (56.3%), creatinine was > 120 μmol/L in 294 (29.3%), lactate was > 2 mmol/L in 470 (42.0%) and albumin was < 35 g/L in 633 (60.8%). Of the 761 (75.2%) study participants that were on ART at the time of ED presentation, 245 (32.2%) were non-adherent as per the ACTG-AQ. Participants not yet on ART prior to ED presentation demonstrated a significantly higher in-hospital mortality than participants on ART (OR 1.69, p =0.002). Younger age, male sex, CD4 <100 cell/mm^3, lack of viral suppression, a high NEWS-2 score (≥7 points), and length of hospital stay ≥7 days were significantly associated with ART non-adherence (p <0.05). Forgetfulness (13.9%), lack of social support, depression/ stress/ mental illness, and lack of transport money to collect medications (9.9% each) were the commonest reasons for ART non-adherence. The median (IQR) hospital LOS was 4.9 (3.5-8.0) days, while the mean (SD) LOS was 6.6 (8.3) days. A total of 381 (31.1%) participants were admitted for ≥7 days. On multivariate analysis of the data, haemoglobin <11 g/dL (OR 1.37, p =0.032), Glasgow coma scale (GCS) <15 (OR 1.80, p =0.001), creatinine >120 μmol/L (OR 1.85, p =0.000), cryptococcal meningitis (OR 2.45, p =0.015) and bacterial meningitis (OR 4.83, p =0.002) were significantly associated with a higher likelihood of hospital LOS ≥7 days, while bacterial pneumonia (OR 0.35, p =0.000) and acute gastroenteritis (OR 0.40, p =0.025) were significantly associated with a lower likelihood of hospital LOS ≥7 days. A total of 166 (13.6%) participants died. On further multivariate analysis of the data, respiratory rate >20 breaths/min (OR 1.90, p =0.012], creatinine >120 mmol/L (OR 1.97, p =0.006), oxygen saturation <90% (OR 2.09, p =0.011), white cell count <4.0 9 10^9/L (OR 2.09, p =0.008), ART non-adherence or not yet on ART (OR 2.39, p =0.012), Glasgow Coma Scale <15 (OR 2.53, p =0.000), albumin <35 g/L (OR 2.61, p =0.002), lactate >2 mmol/L (OR 4.83, p =0.000) and cryptococcal meningitis (OR 6.78, p =0.000) were significantly associated with in-hospital mortality. Apart from

cryptococcal meningitis, the remaining eight of these predictors of in-hospital mortality were included in the final HIV-IMP risk score. After internal validation, the model maintained good discrimination (AUROC 0.83, 95% confidence interval (CI) 0.78 – 0.88) and calibration (Hosmer-Lemeshow $\chi 2$ 2.26, p = 0.895).

Conclusions: Among HIV-positive patients presenting to the CMJAH ED, there was a high prevalence of opportunistic infections, a high prevalence of patients who were either not yet initiated on ART or were ART non-adherent, a high proportion of patients that required prolonged hospital LOS and a relatively high proportion of patients that demised during the course of hospital admission. Various clinical and laboratory parameters were found to be useful in predicting prolonged hospital LOS and in-hospital mortality. These parameters may be of value in guiding clinical decision-making, directing the appropriate allocation of resources, and influencing patient disposition. The HIV-IMP risk score that was developed demonstrated overall good discrimination and calibration and is relatively easy to use.