



Contents lists available at ScienceDirect

Journal of Infection and Chemotherapy

journal homepage: <http://www.elsevier.com/locate/jic>

Note

A preliminary analysis of the performance of a targeted HIV electronic medical records alert system: A single hospital experience

Toshio Naito^{*}, Kanako Endo, Shinichi Fukushima, Mai Suzuki, Yukiko Fukui, Mizue Saita, Hirohide Yokokawa

Department of General Medicine, Juntendo University Faculty of Medicine, Japan

ARTICLE INFO

Article history:

Received 16 June 2020

Received in revised form

17 August 2020

Accepted 6 September 2020

Available online xxx

Keywords:

HIV diagnosis

Screening

Electronic health records

Electronic alert

ABSTRACT

Early treatment of HIV relies on a timely detection of the infection, but many people living with HIV/AIDS are unaware of their infection. In the current study, we applied an electronic medical records (EMR)-based alert system flagging high-risk patients previously diagnosed with infections of syphilis, hepatitis A virus, hepatitis B virus, and/or hepatitis C virus, and those aged 20–50 years with a prior diagnosis of shingles. During the study period (April to October 2019), a total of 47 individuals among 22,264 patients visiting our department were identified as having high-risk of carrying HIV, and 14 of these individuals underwent HIV testing. Two males aged below 65 years with a previous diagnosis of syphilis were subsequently tested positive for HIV. This preliminary analysis of the EMR alert system facilitated the identification of high-risk people possibly carrying HIV, but the test rate remains to be improved.

© 2020 Japanese Society of Chemotherapy and The Japanese Association for Infectious Diseases.

Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

<http://creativecommons.org/licenses/by-nc-nd/4.0/>.

A timely diagnosis of human immunodeficiency virus (HIV) infection could facilitate an early initiation of anti-retroviral treatments in patients. Moreover, those who know that they are infected by HIV may be more likely to take action in preventing transmission. Although Japan has been known to have a low prevalence of HIV with a concentrated epidemic among men who have sex with men (MSM) [1], a recent study estimated that 14.4% of all people living with HIV/AIDS (PLWHA) were undiagnosed in Japan at the end of 2015 using the HIV-positive rates of first-time donors in the national blood donation records [2]. The 2018 Japan HIV surveillance report stated that 1317 of HIV/AIDS cases were notified, and almost 29% of these cases were detected after the development of clinical symptoms, suggesting that many PLWHA may be unaware of their HIV infection [3]. Similar estimations of undiagnosed HIV were found in the US and high-income European countries [4,5].

Abbreviations: EMR, electronic medical records; HBsAg, hepatitis B surface antigen; HCV, hepatitis C virus; HIV, human immunodeficiency virus; IgM-HAV, IgM for hepatitis A virus; MSM, men who have sex with men; PLWHA, people living with HIV/AIDS; STS, serologic test of syphilis; TPHA, treponema pallidum hemagglutination; UNAIDS, United Nations Programme on HIV/AIDS.

^{*} Corresponding author. Department of General Medicine, Juntendo University Faculty of Medicine, Hongo 2-1-2, Bunkyo-ku, Tokyo, 113-8421, Japan.

E-mail address: naito@juntendo.ac.jp (T. Naito).

<https://doi.org/10.1016/j.jiac.2020.09.009>

1341-321X/© 2020 Japanese Society of Chemotherapy and The Japanese Association for Infectious Diseases. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HIV infection is often detected in patients consulting a medical institution for sexually transmitted diseases other than HIV. However, early signs of HIV infection may be overlooked during initial consultation as this is largely dependent on physician's experience and judgement. Therefore, there is a demand for a system that automatically identifies high-risk patients of HIV infection for screening. In MSM, syphilis infection is highly associated with an increased risk of HIV infection compared with heterosexual men [6]. Furthermore, co-infections of HIV with hepatitis viruses is common, and the risk of co-infection in Japan is especially observed in the MSM community [7]. The purpose of this study is to report the preliminary results of applying a targeted HIV alert algorithm to the electronic medical records (EMR) system in the general medicine department to assist the detection of new cases with HIV.

Our alert system identifies high-risk patients eligible for HIV-antibody testing according to existing EMR in Juntendo University Hospital, Japan. The alert system automatically fires an electronic reminder for prescribing HIV testing when the given patient is recognized as having a high likelihood of carrying HIV based on the following criteria: 1) patients who are positive for serologic test of syphilis (STS), *Treponema pallidum* hemagglutination (TPHA), IgM for hepatitis A virus (IgM-HAV), hepatitis B surface antigen (HBsAg), or hepatitis C virus (HCV) antibody, and whose HIV infection status is unknown with an absence of HIV antibody test results documented in the EMR in the recent 5 years; or 2) patients aged

between 20 and 50 years old who have shingles diagnosis and whose HIV infection status is unknown with an absence of HIV antibody test results documented in the EMR in the recent 5 years. For the purpose of increasing the sensitivity of the alert system, syphilis was defined as having records with positive STS or TPHA. Shingles was defined as patients documented having “shingles” as clinical diagnosis in the electronic medical record.

Records from a total of 22,264 patients who visited our department during April 1st to October 31st 2019 were subjected to the HIV early alert system. Patients whose EMR received an electronic alert when the records are called-up by the clinician during the outpatient visit to the Department of General Medicine were advised to undergo voluntary HIV testing. The outcomes of the current study are the number of patients identified needing HIV antibody testing, those who accepted the recommendation, and the result of HIV antibody test.

“Amongst the 22,264 patient-records, there were 27 patients with history of HAV, HBV, HCV, or syphilis; 216 patients with history of shingles. A total of 47 patients (20/27 patients with HAV, HBV, HCV, or syphilis), (28/216 from patients with shingles) were identified as high-risk by the HIV alert system and recommended to take HIV testing during the study period. One patient had two of abovementioned medical conditions. The mean age was 42 years-old, with 7 patients aged above 65 years (14.9%). Almost half of the patients identified as needing a HIV test were males ($n = 22$, 46.8%). The reasons for firing the electronic alert were syphilis positivity (7 cases), HBV infection (6 cases), HCV infection (7 cases), and 20 to 50-year-olds diagnosed with shingles (28 cases) (Fig. 1). None were alerted due to HAV infection. Six males and eight females) were subsequently tested for HIV antibodies, and within these individuals there were 7 cases with syphilis, 2 cases with HBV infection, 2 cases with HCV infection, and 4 cases with shingles (Fig. 1). Ten of the patients who received HIV testing were below the age of 65. Among those who received HIV screening, 2 were detected positive for HIV antibody, resulting in a positive detection rate of 14.3% in those willing to undertake such a test (2 out of 14 patients tested), 4.26% in those identified by the EMR alert (2 out of 47 patients flagged by the alert system), and 0.009% in those who came in our department over the 74 month period (2 out of 22,264 patients seeking medical assistance from the Department of General Medicine). In particular, all 7 patients positive for syphilis and recommended HIV screening by the alert system underwent such testing, and two of them were tested positive for HIV. These two HIV positive patients were both males and aged under 65 years.

Early signs of HIV infection could be overlooked by clinicians, even at the initial consultation for sexually transmitted diseases in the hospital. In the current report, we present the preliminary

results of an electronic HIV alert system, which prompted the detection of HIV in two syphilis positive patients who were unaware of their HIV infection status during the study period. To the best of our knowledge, this is one of the few report presenting the outcome of an EMR alert system designed to identify patients with high-risk of carrying HIV from Japan. Our study is limited by the number of study site, the length of the study period, and perhaps the lack of including other sexually transmitted diseases as the criteria for alert. Nevertheless, the overall HIV positive rate (0.009%) and the male predominance of newly-detected HIV cases (100%) observed in this preliminary analysis was comparable to that previously reported in Japan (0.005% and 96.7%, respectively) [2]. Furthermore, all patients tested positive for syphilis, the only sexually-transmitted disease included in the alert criteria, accepted the recommendation of HIV testing. Although the co-medication and comorbidity burden of life-long antiretroviral treatment in HIV patients should be considered [8,9], it remains important to prevent the spread of HIV infection by promoting early detection and treatment according to the care cascade framework mentioned in the published study [10]. To date, Japan has not met the first two 90-90-90 goals set by the UNAIDS, as only 85.6% of HIV-positive cases were diagnosed and 82.8% of those diagnosed were treated [2]. It was proposed that HIV testing programs should be promoted in high-risk groups including MSM, sexual workers, and injecting drug users in hope of meeting the UNAIDS targets in Japan [2]. An alert system that automatically identifies high-risk patients such as the one applied in our study could assist and contribute to early detection of new HIV infection among PLWHA who are unaware of their infection status. EMR-based alert strategies have been adopted by hospitals in several countries, and those that focused on the high-risk populations of carrying HIV have reported promising results. A recent paper published by an American group demonstrated significantly increased same-day HIV testing rate and test positive rate by an electronic alert strategy that promoted HIV testing when physicians order tests for viral hepatitis or sexually transmitted disease [11]. A clinical decision support system embedded in the EMR prompting physicians to add an HIV test when other tests selected implied that the patient had a higher risk of carrying HIV increased HIV test rates numerically in a UK study, although only 1 in 10 prompts were accepted by physicians [12]. Another electronic alert algorithm similar to our own prompted significantly more HIV testings and new HIV diagnoses in hospitalized patients compared with that prior to implementation of the EMR alert system in a medical center located in Bronx, US [13].

The HIV alert system is valuable in detecting people who are otherwise unaware of their status. Nevertheless, despite the targeted HIV testing protocol specifically recommended to high-risk

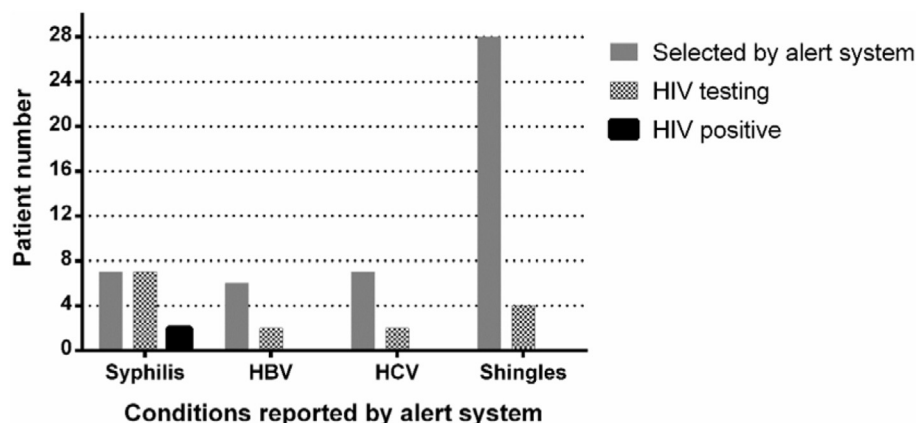


Fig. 1. The cases selected by the electronic medical records alert system as needing a HIV test. HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

patients, the testing rate could still be suboptimal as demonstrated by a study adopting data from national ambulatory survey in the US [14]. Similarly, our data shows there is a large proportion of patients alerted/indicated as requiring a HIV screening, but declined the test. Among the 32 patients who declined the HIV test, there were 4 patients who declined the test due to having received the test in other hospitals, 3 patients positive for shingles declined the test (1 treated with oral steroid for SLE; 2 treated with external steroid for atopic dermatitis). The reasons behind reluctance in accepting the recommendation for the remaining 26 patients were not known, but this could be linked to the perceived stigma against PLWHA [15]. Thus, it is necessary to consider implementation of methods such as consultation, at-home tests, or anonymous testing to increase the patients' willingness to undergo HIV testing after being alerted by the system.

Author contributions

Toshio Naito: Conception and design of the study, Analysis and interpretation of data, Drafting the article and revising it critically for important intellectual content. Kanako Endo and Shinichi Fukushima: Acquisition of data. Mai Suzuki, Yukiko Fukui and Mizue Saita: Conception and design of the study, Analysis and interpretation of data. Hirohide Yokokawa: Analysis and interpretation of data, Drafting the article and revising it critically for important intellectual content. All authors read and final approval of the version to be submitted.

Funding

This work was supported by JSPS KAKENHI Grant Number H30-AIDS-General-008.

Declaration of competing interest

The authors declare that they have no known competing financial interests.

Acknowledgement

We would like to acknowledge CCT JP for English language editing.

References

- [1] UNAIDS. Report to UNAIDS – HIV/AIDS trends in Japan. April 2016. https://www.unaids.org/sites/default/files/country/documents/JPN_narrative_report_2016.pdf. [Accessed 29 April 2020].
- [2] Iwamoto A, Taira R, Yokomaku Y, Koibuchi T, Rahman M, Izumi Y, et al. The hiv care cascade: Japanese perspectives. *PLoS One* 2017;12:e0174360. <https://doi.org/10.1371/journal.pone.0174360>.
- [3] National Institute of Infectious Diseases. Infectious agent surveillance report. HIV/AIDS in Japan. 2018. <https://www.niid.go.jp/niid/images/idsc/iasr/40/476e.pdf>. [Accessed 29 April 2020].
- [4] Raymond A, Hill A, Pozniak A. Large disparities in HIV treatment cascades between eight European and high-income countries – analysis of break points. *J Int AIDS Soc* 2014;17:19507. <https://doi.org/10.7448/IAS.17.4.19507>.
- [5] Centers for Disease Control and Prevention. CDC fact sheet: trends in U.S. HIV diagnoses. 2005-2014. <http://www.cdc.gov/nchhstp/newsroom/docs/factsheets/hiv-data-trends-fact-sheet-508.pdf>. [Accessed 29 April 2020].
- [6] Pathela P, Braunstein SL, Schillinger JA, Shepard C, Sweeney M, Blank S. Men who have sex with men have a 140-fold higher risk for newly diagnosed HIV and syphilis compared with heterosexual men in New York city. *J Acquir Immune Defic Syndr* 2011;58:408–16. <https://doi.org/10.1097/QAI.0b013e318230e1ca>.
- [7] Utsumi T, Lusida MI. Viral hepatitis and human immunodeficiency virus co-infections in asia. *World J Virol* 2015;4:96–104. <https://doi.org/10.5501/wjv.v4.i2.96>.
- [8] Ruzicka DJ, Imai K, Takahashi K, Naito T. Greater burden of chronic comorbidities and co-medications among people living with HIV versus people without HIV in Japan: a hospital claims database study. *J Infect Chemother* 2019;25:89–95. <https://doi.org/10.1016/j.jiac.2018.10.006>.
- [9] Ruzicka DJ, Imai K, Takahashi K, Naito T. Comorbidities and the use of medications in people living with HIV on antiretroviral therapy in Japan: a cross-sectional study using a hospital claims database. *BMJ Open* 2018;8:e019985. <https://doi.org/10.1136/bmjopen-2017-019985>.
- [10] Joint United Nations Programme on HIV/AIDS (UNAIDS). 90-90-90 – an ambitious treatment target to help end the ADIS epidemic. Geneva: UNAIDS; 2014. http://www.unaids.org/sites/default/files/media_asset/90-90-90_en_0.pdf. [Accessed 29 April 2020].
- [11] Hechter RC, Bider-Canfield Z, Towner W. Effect of an electronic alert on targeted HIV testing among high-risk populations. *Perm J* 2018;22:18–1015. <https://doi.org/10.7812/TPP/18-015>.
- [12] Chadwick DR, Hall C, Rae C, Rayment M, Branch M, Littlewood J, et al. A feasibility study for a clinical decision support system prompting HIV testing. *HIV Med* 2017;18:435–9. <https://doi.org/10.1111/hiv.12472>.
- [13] Felsen UR, Cunningham CO, Heo M, Futterman DC, Weiss JM, Zingman BS. Expanded hiv testing strategy leveraging the electronic medical record uncovers undiagnosed infection among hospitalized patients. *J Acquir Immune Defic Syndr* 2017;75:27–34. <https://doi.org/10.1097/QAI.0000000000001299>.
- [14] Hoover JB, Tao G, Heffelfinger JD. Monitoring HIV testing at visits to emergency departments in the United States: very-low rate of HIV testing. *J Acquir Immune Defic Syndr* 2013;62:90–4. <https://doi.org/10.1097/QAI.0b013e3182742933>.
- [15] Ishimaru T, Wada K, Smith DR. HIV testing and attitudes among the working-age population of Japan: annual health checkups may offer an effective way forwards. *Ind Health* 2016;54:116–22. <https://doi.org/10.2486/indhealth.2015-0087>.