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## Triple sexually transmitted virus infection, concurrent human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection; analysis on common drug posing drug-drug interaction possibility

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### ABSTRACT

Sexual contact is an important common activity of human. The medical problem might be due to unsafe sexual contact. An important medical problem due to sexual contact is a sexually transmitted infection. There are several kinds of sexually transmitted infections. Of several infections, concurrent human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections are the three infections that might be transmitted by sexual contact. These three infections are important public health problems at present. There is a chance that there might be a concurrent infection, a triple infection combining human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection. This combo infection is usually a big problem for management. There is a requirement for several drugs for treatment of each disease in this combo while there is a chance of possible drug-drug interaction. In this study, the authors used pharmacology network analysis to assess the drug-drug interaction among drugs for human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection. The Venn diagram analysis is done then the interrelationship map is constructed. Based on this study, a complex web showing drug-drug interaction in the combo infection can be seen indicating the difficulty in management of this common tropical infection.

**Core tip:** In clinical practice, it is not uncommon that a patient might have an infection from more than one sexually transmitted disease. In this study, the authors used pharmacology network analysis to assess the drug-drug interaction among drugs for human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection. In this report, the authors demonstrated the complex drug-drug interaction among antiviral drugs for human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection. The complex can imply a necessary for closed monitoring of antiviral drug administration in any patient with this triple disease. There is also a requirement for an individualized plan for each person to seek the most appropriate drug combination.

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### Introduction

The sexual contact is a basic human activity that is required for reproductive fertility. However, an unsafe sexual contact might result in a medical problem. There are many pathogens that might be transmitted due to unsafe sexual contact. There are many sexually transmitted diseases that are still the global public health problem at present (1,2). The good examples of important sexually transmitted infections are gonorrhea syphilis, human

immunodeficiency virus, and hepatitis B virus and also hepatitis C virus infection. These diseases require good diagnosis and proper clinical management.

In clinical practice, it is not uncommon that a patient might have an infection from more than one sexually transmitted disease. The combo set of sexually transmitted disease is usually an important consideration in clinical practice. The co-occurrence of the three important sexually transmitted viral infection, human immunodeficiency

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virus, hepatitis B virus and hepatitis C virus infection is observable and still an important problem worldwide (3-5). For management of this triple infection, specific drugs for management of each viral infection are available and it is necessary to use several antiviral drugs against the three diseases. An important possible problem in clinical practice is the chance of induction of unwanted drug-drug interaction.

### Objectives

In this paper, the authors conducted a standard pharmacological network analysis to clarify the possible drug-drug interaction among antiviral drugs for human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection.

### Materials and Methods

This study is a standard pharmacological bioinformatics analysis. The possible drug-drug interaction among antiviral drugs available for human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection was assessed using informatics tool. The focused drugs in this study include antiretroviral drugs (nevirapine, efavirenz, lamivudine, tenofovir, zidovudine, rilpivirine, stavudine, atazanavir, lopinavir, ritonavir, abacavir, darunavir and raltegravir), anti-hepatitis B drugs (Lamivudine, Tenofovir and Entecavir) and anti-hepatitis C drugs (Peginterferon alfa-2a, Peginterferon alfa-2b, Ribavirin, Sofosbuvir and Ledipasvir). First, the possible drug-drug interaction among antiviral drugs indicating for management of human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections are assessed using a standard bioinformatics tool namely “interaction checker” (accessible at <https://www.webmd.com/interaction-checker>). Then the identified possible interactions were collected and rearranged to form an interrelationship drug-drug interaction among antiviral drugs. The specific mathematical principle set was also used for writing a Venn diagram presenting the common antiviral drugs in the three antiviral drug groups. Then the creation of the map showing interrelationship drug-drug interaction among antiviral drugs is based on the network pharmacology concept (6,7). The research followed the Tenets of the Declaration of Helsinki.

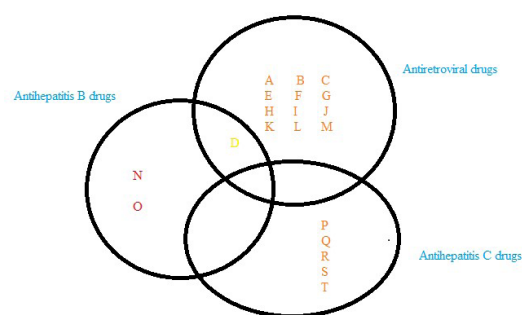
### Results

According to the pharmacological network analysis, there are many predicted possible drug-drug interactions among antiviral drugs against human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection. The Venn diagram presenting the common antiviral drugs that might induce drug-drug interaction among antiviral drugs for the treatment of human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections which are presented in Figure 1. In addition, the interrelationship map showing

possible drug-drug interaction among antiviral drugs for treatment of human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections which are presented in Figure 2.

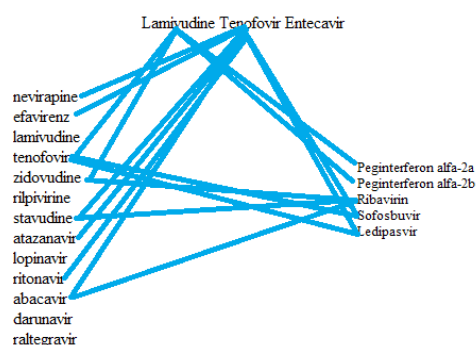
### Discussion

The tropical infections combining human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection is a big combo viral infection problem at present. Due to the continuous persistent of human immunodeficiency virus pandemic, various human immunodeficiency virus-infected patients are registered around the world each year. These patients require clinical management by antiretroviral drugs. However, an important consideration for the management of these patients is the management of concurrent clinical problem which might be an opportunistic or non-opportunistic clinical disorder (8). Regarding sexually transmitted disease, there is a chance that a patient with human immunodeficiency virus might have other sexually transmitted diseases such as hepatitis B virus and hepatitis



**Figure 1.** Venn diagram presenting the common antiviral drugs that might induce drug-drug interaction among antiviral drugs for treatment of human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections.

Abbreviations: A, nevirapine; B, efavirenz; C, lamivudine; D, tenofovir; E, zidovudine; F, rilpivirine; G, stavudine; H, atazanavir; I, lopinavir; J, ritonavir; K, abacavir; L, darunavir; M, raltegravir; P, Peginterferon alfa-2a; Q, Peginterferon alfa-2b; R, Ribavirin; S, Sofosbuvir; T, Ledipasvir.



**Figure 2.** The interrelationship map showing possible drug-drug interaction among antiviral drugs for treatment of human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections.

C virus infection (3-5).

The triple disease combining human immunodeficiency virus, hepatitis B virus and hepatitis C virus infections is an important problem in the present day. This combo usually shows unwanted clinical presentations and requires proper antiviral therapy (3-5). Specific antiviral therapy for each member of the combo, human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection, is available and the concurrent administration of the specific drug for each infection in the combo during the treatment of the triple disease is necessary. In this report, the authors can demonstrate the complex drug-drug interaction among antiviral drugs for human immunodeficiency virus, hepatitis B virus and hepatitis C virus infection. The complex can imply a necessary for closed monitoring of antiviral drug administration in any patient with this triple disease. There is also a requirement for an individualized plan for each person to seek the most appropriate drug combination.

### Conclusion

According to the study, a complex web showing drug-drug interaction in the combo infection can be created indicating the difficulty in management of this common tropical infection.

### Authors' contribution

Both authors wrote the manuscript equally.

### Conflicts of interest

The authors declare that they do not have any conflicts of interest.

### Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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