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# Chemistry of Pre-exposure Prophylaxis (PrEP) and Brazil's Protagonism in the Fight Against HIV/AIDS: Exploring the Theme with High School Seniors

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The Pre-exposure Prophylaxis (PrEP) for the prevention of human immunodeficiency virus (HIV) infection consists in using antiretroviral medicine before sexual exposure to the virus to decrease probability of infection. The PrEP is capable of preventing the virus infection and promoting a healthier sexual life. Brazil has been a reference in HIV treatment not only because it was the first country in Latin America to offer free antiretroviral treatment to virus carriers but also because it participated in the Initiative in Pre-exposure Prophylaxis (iPrEP), a study that was carried out in several countries worldwide and proved effectiveness of the PrEP. Medication distributed by the Brazilian Public Health System (SUS) is quite unknown to the population. To mitigate current proliferation of sexually transmitted diseases (STDs) and increase in pregnancy cases among adolescents, sexual orientation has been intensified in schools and, thus, it has also become their responsibility, rather than parents' responsibility alone. Therefore, this study aimed at carrying out dynamic and dialogic interventions about the PrEP in classes taught to High School seniors who attend technical courses in Commerce and in Development of Digital Games at the Instituto Federal do Triângulo Mineiro - *Campus* Uberlândia Centro, Uberlândia, Minas Gerais (MG), Brazil. A dialogical Chemistry class was taught to show students several images and chemical structures of active ingredients found in the medication (PrEP). Besides, students answered a questionnaire with open questions anonymously to evaluate the effect of the class on their learning about sexual education, HIV/AIDS and, mainly, the PrEP. Students showed much interest in the tasks and interacted positively. Results of the questionnaire enabled to observe students' increase in knowledge about the PrEP. In sum, this study enabled the PrEP to be better disseminated, since doubts were mitigated.

## Graphical abstract



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## 1. Introduction

Sexuality has gone through several perceptions in the course of history, depending on the context, which may be either oppressive or libertarian. Changes in historical scenarios have directly influenced views on sexuality and have ruled behavior patterns [1].

Repression and condemnation of sex have led to lack of knowledge about the body and sexual behavior and contributed to marginalization of the themes and proliferation of sexually transmitted diseases (STDs). In Brazil, discussions on insertion of sexual education in schools have had ups and downs, following the country's historical context. For instance, in 1970, the National Committee of Moral and Civism voted against the 1968 Bill which proposed that sexual education should be mandatory in school curricula. Nowadays, to mitigate both proliferation of cases of Acquired Immunodeficiency Syndrome (AIDS) and increase in pregnancy cases among adolescents, sexual orientation has been intensified in schools. Thus, sexual education, which used to be taught to children by parents, has also become responsibility of school [1].

In schools, sexuality has moved along with advances and transformations in society. The National Parameters of Curricula (NPCs) state that the theme human body and health should be addressed in the fourth grade in Elementary School. The first issues are puberty, reproduction and STDs while others are added in High School [1]. However, the way in which the content, mainly STDs, is taught in High School is questionable since students keep quite distant from the theme sex and its implications. It makes us question whether there are differentiated teaching methods that address the theme efficiently in Brazilian High School.

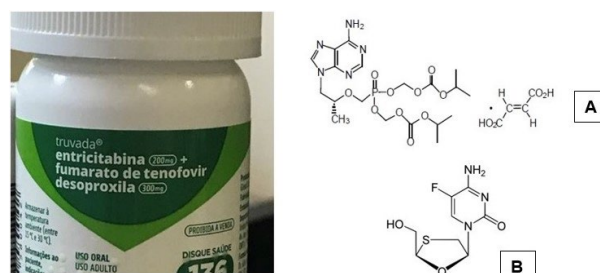
It is important to address prevention of STDs and methods that promote protection, mainly to adolescents, since they are in the phase of risky sexual behavior, drug use or lack of information, mainly in lower-income households, where persons are more susceptible to STDs (the well-known discovery phase). Aiming at disseminating knowledge, we decided to develop a research project with High School seniors to investigate the activity of a current medicine that has often been used in the so-called Pre-Exposure Prophylaxis (PrEP).

The PrEP has been highlighted as an opportunity to change the situation of human immunodeficiency virus (HIV) prevention since it is a new alternative protection [1]. Because it proposes that HIV negative persons should use antiretroviral medication to prevent it, the PrEP has been the target of biomedical studies of combination therapy [2].

In this scenario, the PrEP has complemented barrier methods against sexually transmitted diseases by means of prophylactic administration of antiretroviral medication to persons at high risk of exposure. A formulation that combined tenofovir (TNF, Figure 1) and emtricitabine (FTC, Figure 1) was approved by the Food and Drug Administration (FDA) in the USA in 2012 while the PrEP was only implemented by the Brazilian Public Health System (SUS) in 2018 [3,4].

This study aimed at carrying out dynamic and dialogic interventions about the PrEP in classes taught to High School seniors at the Instituto Federal do Triângulo Mineiro - *Campus* Uberlândia Centro, Uberlândia, Minas Gerais (MG), Brazil. Thus, it evaluated students' previous knowledge and enabled them to learn about this current theme. In addition, in Chemistry classes, different strategies were used for

contributing to students' awareness regarding the importance of sexual education to decrease the risk of infections caused by STDs.



**Fig. 1.** Pre-exposure Prophylaxis (PrEP): free medication offered by the Brazilian Public Health System (SUS), widely known as Truvada®. Chemical structures of *tenofovir disoproxil* (A) and *emtricitabine* (B).

## 2. Material and Methods

This study was conducted with two groups of High School seniors at the Instituto Federal do Triângulo Mineiro - *Campus* Uberlândia Centro, Uberlândia, MG, Brazil. Both groups totaled 57 students; all of them said to their Chemistry teacher that they had some previous knowledge about the issue – STDs – which had been addressed in Biology lessons.

The tool used for data collecting was a questionnaire with open questions that we developed. It was anonymously answered by students and encompassed several issues, such as sexual education, STDs and, mainly, the PrEP. Questionnaires applied to seniors who attend courses in Commerce and in Development of Digital Games consisted of the following eight questions.

### Questionnaire of the study:

- 1) Do you feel embarrassed to talk about sex, sexual education, sexually transmitted diseases (STDs) and related issues?
- 2) Do you think that it is important to address sexual education in High School classes?
- 3) Which STDs do you know?
- 4) Is it possible to get contaminated with more than one STD at once?
- 5) Should sexually active adolescents undergo sexual health check-up regularly?
- 6) Is talking about HIV/AIDS still a taboo subject for you?
- 7) What is the human immunodeficiency virus (HIV) treatment like?
- 8) Do you know what the Pre-exposure Prophylaxis (PrEP) is?

In sum, this study evaluated how qualitative didactic intervention may help students to participate in discussions about themes which are considered, by many persons, "sensitive matters/taboo". Besides, answers given to the questionnaire were quantitatively analyzed.

### 3. Results and Discussion

The qualitative didactic intervention was positively accepted by all students. When the teacher spoke about the task that would involve situations and problems related to sexual education in Brazil, students showed interest, became more inquisitive and brought up several curiosities. Their thirst for knowledge should be highlighted since their active participation enabled the theme to be easily addressed. When the Chemistry teacher included the theme PrEP, students' questions and facial expressions made it clear that this issue was not familiar to them and that they did not even know about the existence of the PrEP, a current and effective way to prevent HIV.

The quantitative evaluation of this study was based on the analysis of data collected by questionnaires answered by 57 students. Twenty-seven out of 57 students are males while 30 are females; 80% of students are between 16 and 18 years old.

The first question of the questionnaire aimed at getting some information on what is often a terrible issue to discuss with parents at home. The analysis of the answers showed that 70% of interviewees do not feel embarrassed to talk about sex, sexual education and STDs with anyone. They also stated that the topic is treated naturally by their parents at home since they connected to the modern times and do not impose any barrier to any subject. On the other hand, 30% of students still feel uncomfortable when they talk about the topic and do not feel free to expose their ideas about it at home. According to Furlanetto and collaborators (2019) [5], adolescence is the stage of the vital cycle which is characterized by biological and psychosocial changes in which adolescents usually get more autonomy. The authors state that adolescents think that information on sexuality transmitted by family members and the school is insufficient, mainly because of embarrassment shown by those who want to talk about the theme [5].

Regarding the second question, 100% of students answered that it is important to discuss sexual education in class. Sfair et al. (2015) [6] state that sexual education in High Schools should strengthen adolescents and the young by increasing their self-esteem towards their bodies and values and make them aware of others, even though they may be different. The theme must be demystified so that pleasure, feelings, respect and responsibility are addressed, rather than only risks of sexual behavior [6].

When students were asked about which STDs they knew, all of them mentioned at least one. The most cited diseases were HIV/AIDS (65%), syphilis (20%), human papillomavirus (HPV) (10%), herpes (3%) and gonorrhea (2%). Taquette et al. (2004) [7] carried out a study named *STDs in adolescence: a study of risk factors* and emphasized that orientation about the beginning of sexual life, mutual fidelity, decrease in the number of partners and elimination of risky sexual practices are important factors that must be discussed with adolescents. The situation urges the development of effective strategies to reach the objectives. Adolescents have to be listened to as participants in the process since ready solutions are useless.

The fourth question asked students whether contamination with more than a type of STD could happen at once. Answers showed much divergence, i. e., 73.7% of interviewees said that it is common to have or get more than a STD at once while 26.3% said that it may happen but it is rare. Literature reports show that it is common to find a person with several STDs at the same time. Re-infection is also

common, which means that people get cured but are re-infected. The World Health Organization (WHO) informs that about a million people get an STD everyday and that 500 million people get a curable STD (gonorrhea, chlamydia, syphilis and trichomoniasis) per year [8].

Concerning the fifth question, all adolescents stated that sexually active youngsters must undergo regular sexual health check-up prescribed by urologists and gynecologists. Besides, some reported that they know the check-up is necessary but do not know how to talk to their parents about this type of care. Rodrigues and Fernandes (2019) [9] mentioned that the young may behave differently when they are accompanied by parents to see a physician. Parents also play a key role in medical assistance. There are situations in which physicians must consider adolescents' safety and balance the bioethical pillars of Medicine to justify confidentiality breach [9].

Regarding the sixth question, 100% of adolescents answered that there is no problem with talking about HIV.

Answers given to the seventh question showed that all students knew that people infected with the virus were treated with antiretroviral medication provided by the SUS. All students gave excellent answers since they explained that the medication may not only retard progression of the disease significantly but also prevent secondary infections and complications. Neither the sixth nor the seventh question posed any difficulty to the students.

Finally, the eighth question is in fact the one that attributed novelty to this study, since there is no study of teaching/dialogue about the PrEP to High School adolescents in the literature. Further discussion about the PrEP took place in informal conversations in class. The following issues were brought up: how can we use the PrEP? Who should use it? Is the drug available in the market? Have you ever used the PrEP? Do you know anyone who has already used it?

Questions mentioned in the previous paragraph were triggered by the eighth question as the result of the disturbing fact that 100% of students had never heard about the PrEP.

The Chemistry teacher used the opportunity to highlight the importance of the medication nowadays. Clinical assays have shown that the PrEP is safe and that PrEP adherence has decreased incidence rates of HIV significantly [2]. Daily use of PrEP may prevent HIV from establishing and spreading in the body. Infectologists have reinforced that PrEP only acts if you take the medication everyday. Otherwise, there may not be enough concentration of active compounds in your bloodstream to block the virus [10]. The teacher contextualized the theme by asking students to analyze the chemical structures of active ingredients found in the medication (Figure 1) and to identify organic functions found in its molecules. Since participants were High School seniors, they perfectly identified organic functions they had learned before (Figure 2).

In their contextualized classes, Chemistry teachers usually give examples of chemical structures of active principles found in medication so that students may identify organic functions they have learned.

Researchers in the field of Chemistry teaching have highlighted that it is not easy to find a theme that connects everyday life to concepts that have to be taught in Chemistry classes. Thus, the theme *medication to teach organic functions* is not only conceptually rich but also enables teachers to work with molecules which exhibit several

functional groups in their structures [11].

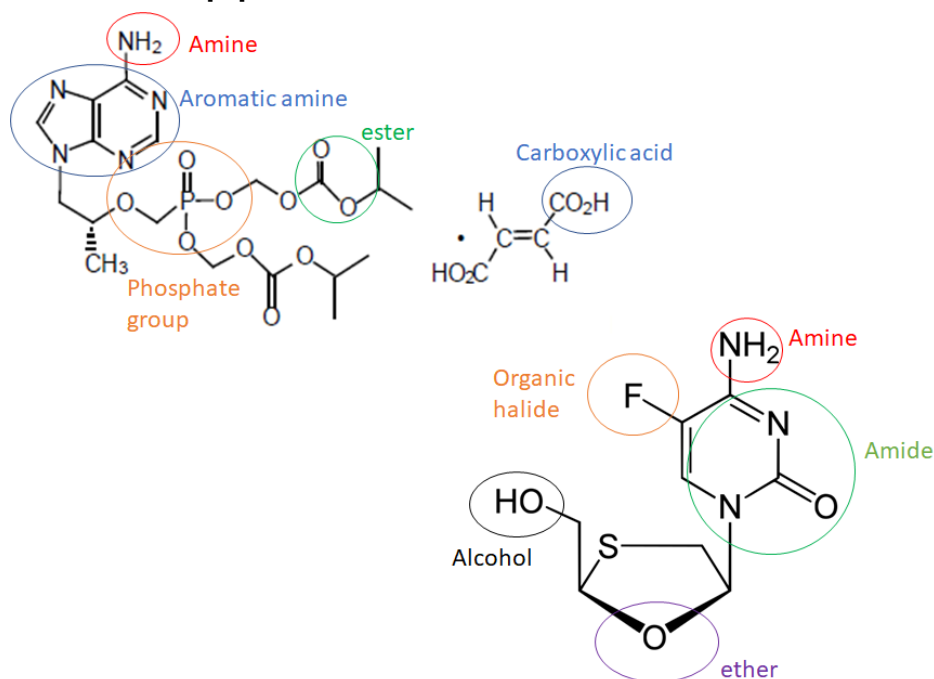


Fig. 2. Chemical structures of active ingredients of Truvada® and organic functions identified by High School seniors at the Instituto Federal do Triângulo Mineiro - Campus Uberlândia Centro, Uberlândia, MG, Brazil.

## 4. Conclusions

Besides Health Departments, schools play a fundamental role in disseminating themes related to STDs and similar issues. The young spend a lot of time in their households and, secondly, in schools. This novel study showed how important it was to use a Chemistry class to discuss the PrEP with students. Regarding HIV prevention, the school community must be continuously guided and taught so that knowledge becomes part of the culture and everyday behavior. This evidence reinforces that health services, schools (when they are responsible for teaching sexual education in class), media and families need to work together to ensure efficacy and decrease the number of cases of HIV infection.

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## Author Contributions

M.C.L and M.L.D.M. outlined the whole research project which was carried out with two High School groups (seniors) at the IFTM-UDICENTRO. All authors conducted the systematic literature review. All authors contributed to the writing of the manuscript. M.L.D.M was in charge of the final review and submission to *Orbital: The Electronic Journal of Chemistry*.

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