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ENHANCING HIV INDICATOR DISEASE-GUIDED TESTING STRATEGY IMPLEMENTATION IN ESTONIA BY USING HIV CLINICAL DECISION SUPPORT SYSTEM - A PILOT STUDY IN PRIMARY CARE

Master's Thesis

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HIV INDIKAATORSEISUNDITEL PÕHINEVA HIV TESTIMISE STRATEEGIA ELLUVIIMINE EESTIS KASUTADES ELEKTOONILIST HIV OTSUSTUSTOE SÜSTEEMI - PILOOTUURING ESMATASANDI PEREARSTIKESKUSTES

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Author's declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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Abstract

The aim of this research was to evaluate whether an HIV clinical decision support system (HIV CDSS) designed to follow indicator condition-guided HIV testing strategy increases the rate of HIV diagnostic tests done by a primary care professional and how feasible the approach is to integrate HIV CDSS in primary care level in Estonia. To measure and analyse the feasibility of the HIV CDSS the quasi-experimental study design was used. The method has been used in several similar studies before and it allowed to analyse the HIV testing rates done before the intervention (pretest) and after the intervention (posttest) was introduced.

The research findings show that integrating HIV CDSS into general practitioners' medical platform increases the HIV testing rates four times. All the participants including general practitioners, residents and nurses agreed, that the HIV CDSS will help to enhance the implementation of the HIV indicator condition-guided testing method in Estonian primary care level.

The author of this research analysed the prevalence of the indicator conditions diagnosed in Estonian primary care level. During the 6-month period, 268 patients diagnosed with at least one indicator condition had an appointment with their health care provider. 13% of eligible patients had 2 indicator conditions diagnosed and 2% of the study population had at least 3 HIV indicator condition diagnosed. The most frequently identified indicator conditions were candidiasis (25%), candidiasis of vulva and vagina (12,7%), atypical psoriasis (8,7%), unspecified fever (7,1%), herpes zoster (6,7%), unspecified pneumonia (5,6%), seborrhoeic dermatitis (4,8%), zoster without complications (3,6%) and other specified predominantly sexually transmitted diseases (2,8%). 3,6% of the identified diagnosis were categorised as AIDS defining conditions among people living with HIV.

An online questionnaire was used to gain insights about the health care providers' attitudes towards the provider-initiated indicator condition-guided HIV testing approach and analyse barriers and facilitators to use HIV CDSS. Similarly, to other studies the

HIV CDSS was widely accepted and agreed to be feasible solution for the Estonian primary care level. 88,9% of participants reported that they wish to use this HIV CDSS in the future to enhance the HIV indicator condition-guided HIV testing method. 77,8% of participants agreed that the novel and innovative method should be included in the primary health care quality system. One of the participants stated that it is too early to include indicator condition-guided testing into the quality system as general practitioners need specific HIV medical guidelines. The HIV medical guideline should cover the main barriers the health care providers are facing towards the HIV indicator condition-guided testing strategy. Listed barriers included the need to revisit the list of indicator conditions and the agreement on timeframes when new HIV tests should be provided.

88,9% of the participants reported that the HIV CDSS will help to find undiagnosed patients and enhance the HIV prevention. 77,8% answered that the HIV CDSS will increase the patients' awareness about the HIV infection.

This thesis is written in English and is 73 pages long, including 6 chapters, 3 figures and 6 tables.

Annotatsioon

HIV INDIKAATORSEISUNDITEL PÕHINEVA HIV TESTIMISE STRATEEGIA ELLUVIIMINE EESTIS KASUTADES ELEKTROONILIST HIV OTSUSTUSTOE SÜSTEEMI – PILOOTUURING ESMATASANDI PEREARSTIKESKUSTES

Magisttöö eesmärgiks oli hinnata HIV indikaatorseisunditel põhineva HIV testimise strateegia ja HIV otsustustoe rakendatavust Eesti esmatasandil. HIV otsustustoe rakendatavuse analüüsiks ning hindamiseks kasutas autor pilootuuringu läbiviimisel eksperimentaaluuringu meetodit (*quasi-experimental study*). Antud meetodi abil analüüsiti HIV testimist interventsioonile eelneval perioodil (*pretest*) ning interventsioonile järgneval perioodil (*posttest*).

Uuringu tulemused näitavad, et integreerides HIV otsustustoe algoritmid esmatasandi meditsiiinitarkvara üheks komponendiks, on võimalik HIV testimist suurendada Eesti esmatasandil neljakordselt. Kõik uuringus osalenud perearstid, residendid ja pereõed nõustusid, et digitaalne meeldetuletus HIV testimisest aitab suurendada indikaatorseisunditel põhineva HIV testimise strateegia elluviimist Eestis.

Magistritöö tulemusena analüüsiti indikaatorhaiguste levimust Eesti esmatasandil. 268 patsiendil, kes külastasid perearstikeskust kuue kuu vältel, oli diagnoositud vähemalt üks HIV indikaatorseisund. 13% patsientidest oli diagnoositud kaks indikaatorseisundit ja 2% patsientidest oli vähemalt kolm indikaatorseisundit diagnoositud. Kõige sagedamini diagnoositud indikaarorseisund esmatasandil oli kandidiaas (25%), häbeme- ja tupekandidiaas (12,7%), harilik psoriaas (8,7%), täpsustamata palavik (7,1%), vöötohatis (6,7%), täpsustamata kospupõletik (5,6%), seborröadermatiit (4,8%), tüsistusteta vöötohatis (3,6%) ja peamiselt sugulisel teel levivad muud täpsustatud haigused (2,8%). 3,6% indikaatorseisunditest kuulusid AIDSi defineerivasse kategooriasse.

Magistritöös kasutatud veebipõhine küsimustik aitas analüüsida esmatasandi tervishoiutöötajate suhtumist HIV indikaatorseisunditel põhinevasse HIV testimise meetodisse ning leida peamised barjäärid ning kasutegurid HIV otsustustoe

rakendamiseks. Sarnaselt paljudele rahvusvahelistele uuringutele on ka antud magistritöös esmatasandi tervishoiutöötajate vastuvõtlikkus HIV otsustustoele väga kõrge. 88,9% tervishoiutöötajatest vastasid, et sooviksid HIV otsustustuge kasutada ka tulevikus, et HIV indikaatorseisundutel põhinevat HIV testimist parendada esmatasandil. 77,8% osalejatest vastasid, et näeksid HIV indikaatorhaigustel põhinevat testimist ühe kvaliteediindikaatorina Eesti perearstide kvaliteedisüsteemis. Samas tuleb märkida, et üks tervishoiutöötaja tõi välja, et selle lisamine tänasel kujul kvaliteediindikaatoriks on liiga ennatlik. Esmalt oleks osaleja sõnul vaja koostada konkreetne ravijuhis, mis kataks teemad, mida oli nimetatud ka suurimateks barjäärideks kasutamaks indikaatorseisunditel põhinevat HIV testimist. Nimetatud barjäärid olid indikaatorseisundite ülevaatamine ja erinevate osapooltega kokku leppimine ajaperioodis, mil teste peaks kordama.

Peamisteks kasuteguriteks HIV otsustustoel nähti võimalust leida diagnoosimata patsiente (88,9%) ja parendada HIV ennetust esmatasandil (88,9). Lisaks eelnevale toodi osalejate poolt välja (77,8%), et HIV otsustustugi aitab tõsta ka patsientide teadlikkust HIV temaatikast.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 73 leheküljel, 6 peatükki, 3 joonist, 6 tabelit.

List of abbreviations and terms

AIDS	Acquired immunodeficiency syndrome
ART	Antiretroviral therapy
CDSS	Clinical decision support system
ECDC	European Centre for Disease Prevention and Control
ENIHD	Estonian National Institute for Health Development
EEA	European Economic Area
EU	European Union
GP	General practitioner
GPs	General practitioners
HIV	Human immunodeficiency virus
HTC	HIV testing and counselling
IC	Indicator condition
IC-guided HIV testing	Indicator condition-guided HIV testing
PLWHA	People living with HIV/AIDS
PMTCT	Prevention of mother-to-child transmission
STDs	Sexually transmitted diseases
UNAIDS	United Nations Programme on HIV/AIDS
WHO	World Health Organization

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1 Introduction

1.1 Background and research focus

The world faces several global health challenges in the near future starting from fighting air pollution, increasing and spreading knowledge about the next global influenza pandemics, increasing the global coverage of vaccinations and fighting against the human immunodeficiency virus (HIV). The World Health Organization (WHO) states in their annual strategy overview that above mentioned challenges would be their next focus areas in 2019 and onwards [1].

Even though the effort against HIV has been remarkable, the epidemic continues to spread intensively. In 2017, 36,9 million people were diagnosed with HIV infection globally. Every year approximately 1,8 million people become newly infected with HIV, and 1 million people die from AIDS-related illnesses globally [2]. HIV infection affects more than 2,3 million people in the WHO European region and 159 420 newly diagnosed HIV infections were reported by the WHO European region countries in 2017. It corresponds to a rate of 20,0 newly diagnosed infections per 100 000 population. Although newly diagnosed infections have decreased by one third in Estonia (291 to 190) during the last five years (2014-2018), Estonia still has one of the highest newly infected rates in Europe. According to data reported by 30 countries of the EU/EEA countries in 2017, the highest rates of new HIV diagnoses were reported by Latvia (18.8; 371 cases) and Estonia (16.6; 219 cases) [3].

In 2014, the United Nations Programme on HIV/AIDS (UNAIDS) defined an ambitious goal to end the AIDS epidemic worldwide by 2030. UNAIDS stated that 90% of people living with HIV are aware of their HIV status, 90% of people who know their HIV-positive status will be accessing treatment and 90% of people on treatment will have suppressed viral loads. This goal has been widely accepted by many global stakeholders and by the end of 2017, the world had achieved 75-79-81 compared to the targets named earlier [4]. The most significant gap remains at the first 90 per cent that focuses on people living with HIV and their HIV status awareness. European region surveillance

data shows that one in three are unaware of their status (700 000 - 900 000 individuals) and remain undiagnosed [5]. In Estonia, the latest national reports state that by the end of 2016, it was estimated that around 916 people (95% confidence interval (CI) 756-1125) had undiagnosed HIV status [6].

Undiagnosed individuals are usually entering HIV care very late, causing adverse effects not only for the individual but also for the broader population. According to the 2018 report from European Centre for Disease Prevention and Control (ECDC), 53% of people living in WHO European region are detected when their CD4 cell count has fallen below 350 per mm^3, including 32% with advanced HIV infection (CD4 < 200/mm^3) [3]. Late diagnosis of HIV infection has been associated with increased mortality and morbidity, increased transmission rates as HIV infected people are unable to adopt risk reduction behaviours to reduce onward transmissions, weaker response to effective treatment and increased cost to healthcare services [7].

As European region surveillance data illustrates, late presentation is strongly correlated with insufficient access, provision and uptake of HIV testing for those most at risk. Therefore, HIV testing strategies need to be reconsidered and broadened to meet current HIV transmission trends and patterns [3]. Recently published HIV medical guidelines are suggesting to adopt more targeted and provider-initiated HIV testing strategies. Many European guidelines including Estonian national HIV testing guideline published in 2012 are emphasizing and recommending the indicator condition-guided HIV testing (IC-guided HIV testing) approach [7] [8] [9] [10]. This approach is an acceptable, feasible and effective strategy to address the on-going HIV epidemic in Europe to reduce the number of undiagnosed HIV individuals and enhance earlier diagnosis [11]. As certain indicator conditions occur more often in HIV infected people, either because they share a common way of transmission or because their occurrence is accelerated by the immune deficiency associated with HIV infection [12]. However, there is little evidence-based research done in Estonia concerning the prevalence of HIV infected individuals who are currently unknown but still presenting for primary health care with indicator conditions.

The overall number of HIV tests performed in the European region increased by 34%, from 17 551 854 in 2008 to 23 436 301 in 2017 [3]. According to the Estonian National Institute for Health Development (ENIHD) report published in 2018, the number of

tested individuals in 2017 was 71 733. The number of people tested had increased by 22% compared to the previous year (2016) and tests done by general practitioners (GPs) has increased as well, but is still very limited (0,5% among 20-49 years old insured patients) [13]. Despite the increased number of HIV tests performed, the number of undiagnosed individuals has not dropped drastically. That indicates the necessity to test in a more targeted way and expand healthcare providers that are performing HIV tests.

Primary health care plays an enormous role in provider-initiated HIV testing strategy for early case-finding. GPs are usually the first contact points for patients to access healthcare services. Several studies have discovered huge percentages of missed opportunities for indicator condition-guided testing in primary health care. Ivo K Joore et al. published an article in 2015 with the results showing that 5 years before getting HIV diagnosis, 58,8% of HIV cases had an HIV indicator condition diagnosed (compared with 7,4% of controls), and 61,8% of cases visited their GPs at least once in the year prior to HIV diagnosis [14]. The Estonian National Institute for Health Development analysed The Estonian Health Insurance Fund's data collected between 2014-2015. During those years, 538 individuals were diagnosed positive, and 71% of them had several contacts with their GP two years before being diagnosed with HIV [15].

There is an great need to identify the barriers and facilitators that affect GPs to implement IC-guided HIV testing into their everyday practice effectively. The focus of this research paper is to identify the main barriers and facilitators Estonian GPs are facing to follow IC-guided HIV testing guidelines that are published and widely accepted since 2012.

Evidence from numerous studies has shown that IC-guided HIV testing strategy incorporated with automated clinical decision support systems and clinical reminders are successfully helping to increase targeted HIV testing frequency (from 4,8% to 10,8% [16]) and patients' acceptance (median uptake 96% [12]). It removes the need for HIV risk assessment as the IC itself acts as a trigger for offering HIV testing, therefore reducing HIV-related stigma and discrimination towards patients, and normalizing HIV testing [17].

This research paper focuses on piloting a clinical HIV decision support system to analyse the possibilities of finding population-based insights to enhance the IC-guided HIV testing strategy implementation in the Estonian primary health care sector. Previous studies worldwide have mainly used retrospective analysis, but there is a lack of experiment-based studies implementing IC-guided testing approach with automated algorithms in real life conditions.

Furthermore, the paper aims to gain meaningful insights on how much IC-guided HIV testing strategy differs from current everyday practice. This research paper is analysing primary health centres HIV testing rates before and after using automated algorithms.

In the literature review, the research is focusing on describing HIV testing methods by analysing their barriers and advantages, exploring clinical decision support systems and clinical reminders designed to enhance IC-guided HIV testing approach and measure their impact on a broader scale.

1.2 Overall Research Aim and Objectives

The overall aim of this research paper is to evaluate whether an HIV decision support system (HIV DSS) designed to follow indicator condition-guided HIV testing strategy, increases the rate of HIV diagnostic tests done by a primary care professional and how feasible the approach is to integrate HIV DSS in primary care level in Estonia.

This research paper is executing an experiment-based study to analyse the prevalence of HIV indicator conditions diagnosed and treated in the primary care level and focuses on measuring and analysing the impact of HIV DSS intervention.

The objectives of this research paper are to:

1. *Analyse* HIV indicator conditions prevalence in the Estonian primary care level.

2. *Compare* two different HIV testing strategies: HIV indicator condition-guided HIV testing strategy with current everyday practice.

3. *Evaluate* the impact of digital reminders in primary health centres (using HIV DSS).

4. *Integrate* HIV DSS algorithms into general practitioners' medical platform to measure its feasibility and the readiness to use it by the GPs.

To accomplish the aim and objectives of this paper, the following research topics and questions are defined:

The prevalence of HIV indicator conditions and HIV testing in primary health centres:

1. Which HIV indicator conditions were mostly diagnosed and treated in primary health centres?

2. Which HIV indicator conditions are not treated nor diagnosed in primary health centres?

3. Which HIV indicator conditions led to suggesting HIV testing?

4. How many HIV tests were carried out 6 months before starting with the intervention in primary health centres?

5. How many HIV tests were carried out during the intervention?

The diagnosis and e-referrals from GPs to infectious disease doctor:

1. How many patients got an e-referral to an infectious disease doctor?

2. How many patients got the HIV diagnosis?

Patients' acceptance of participating in the study and taking an HIV test:

1. What is the percentage of acceptance to participate in the study group but declined taking an HIV test?

2. What percentage of patients accepted to take an HIV test but declined to participate in the study?

3. What were the main reasons for declining an HIV test or participating in the study?

GPs' attitude and usage of the HIV DSS:

1. What kind of feedback was provided for the HIV DSS by the participating GPs?

2. How well did they manage to update their medical platforms to use the HIV DSS solution?

3. What were the main barriers for using HIV DSS?

4. What were the main facilitators for using HIV DSS?

5. How many digital reminders were declined, and what were the reasons?

2 Literature overview

2.1 Epidemiology of HIV infection, missed opportunities and the necessity of early detection

Acquired Immune Deficiency Syndrome (AIDS) of humans is caused by two viruses, human immunodeficiency viruses type 1 and 2 (HIV-1 and HIV-2). HIV is believed to have entered the human population through cross-species transmission from non-human primates in Africa [18]. HIV-1 type has been transmitted from apes (M, N, O, and P) and HIV-2 type from monkeys. The HIV-1 group M has been the leading cause of the global epidemic ,whereas HIV-2 is primarily restricted to the West Africa region [19]. In this research paper, the author will discuss HIV-1 infection and will refer to the virus as HIV.

HIV infection has rapidly spread since the early 1980s and is still causing approximately 1 million deaths every year globally. There have been 35,4 million AIDS-related deaths since the start of the epidemic, and 36,9 million people were globally living with HIV in 2017. In 2017, 25 353 individuals were diagnosed with HIV infection in the European Union and European Economic Area (EU/EEA) corresponding to a rate of 6,2 newly diagnosed infections per 100 000 population. The highest rate of newly diagnosed HIV cases in the EU/EEA were reported by Latvia (18,8; 371 cases) and Estonia (16,6; 219 cases) in 2017 [2].

European region surveillance data shows that one in three are unaware of their status (700 000 - 900 000 individuals) and remain undiagnosed [5]. In Estonia, the latest national reports state that by the end of 2016, it was estimated that around 916 people (95% confidence interval (CI) 756-1125) had HIV status undiagnosed [6]. Undiagnosed individuals are usually entering HIV care very late, causing adverse effects not only for the individual but also for the wider population. These individuals have usually

developed serious AIDS-defining condition [20] as HIV attacks the body's immune system lowering the number of CD4 cells that are helping the immune system to fight against infections. HIV is a lentivirus or "slow" virus and is known for having a long period between the initial exposure and the beginning of long-term symptoms leading to the disease [21]. Untreated and prolonged HIV infection can destroy so many CD4 cells that the weakened body's immune system is starting to cause opportunistic infections or cancers [22]. According to the 2018 report from European Centre for Disease Prevention and Control (ECDC), 53% of people living in WHO European region are detected when their CD4 cell counts have fallen to below 350 per mm^3, including 32% with advanced HIV infection (CD4 < 200/mm^3) [3].

Individuals who know their HIV status as early as possible can benefit from prophylaxis for opportunistic infections to reduce HIV-related morbidity; treatment for sexually transmitted diseases (STDs) can reduce the risk of HIV transmission; treatment of substance abuse and mental health conditions can reduce HIV risk behaviour; and use of antiretroviral therapy (ART) has the most promising effect on morbidity and mortality [23]. The availability of antiretroviral therapy has decreased HIV related morbidity and mortality dramatically, and most infected people are now living with HIV as a chronic condition rather than an inevitably fatal illness [24].

In addition to improving an individual's well-being, early detection should be a critical public health strategy for countries' representatives. Earlier diagnosis and HIV treatment (ART) are together considered to be a cost-effective approach as it leads to better health outcomes, avoidance of high-cost morbidity and hospitalizations, and individuals' ability to participate in the workforce [24]. The article conducted by Krentz et al. (2004) compared the mean annual costs for healthcare for late presenters (CD4 < 200/mm^3) and early presenters (CD4 > 200/mm^3). The mean annual cost for late presenters was 2,2 times higher than for early presenters (Canadian $18 557 vs $8455) [25].

There is a large amount of evidence that late presenters have been in contact with healthcare providers before being diagnosed. It results in high levels of missed opportunities to diagnose and avoid significant morbidity and mortality. In France, like in many European countries, one out of three HIV infected patients are diagnosed at an advanced stage of the disease. Champenois et al. (2013) conducted a study in France, where they found that 89% out of 1008 newly HIV-diagnosed patients had seen a

general practitioner at least once a year during the 3 years before to getting the HIV diagnosis. Similar findings are reported in Germany, where Tominski et al. (2017) reported that 21% of late presenters with at least one HIV indicator condition had prior contact with healthcare providers without being offered an HIV test. Lhopitallier et al. (2018) made a retrospective analysis at a Swiss university hospital where they identified 201 eligible patients. 47% of patients had at least one previous appointment with healthcare professionals and an indication for HIV tests, but it was not offered by the provider, accounting as missed opportunities to diagnose HIV earlier [26].

To reduce the time for diagnosing and the number of missed opportunities, many countries, including Estonia, have implemented several preventive strategies at the same time. It is not sufficient to fight against the current HIV epidemic with the single HIV prevention approach.

The next chapter will discuss different HIV prevention methods. There is a need to view prevention interventions as "combination interventions", where programs are using mixed-methods of biomedical, behavioural, and structural interventions [27]. This research paper is describing the above-mentioned methods in more detail, but the main focus relies on comparing HIV testing strategies.

2.2 HIV prevention and testing strategies

Despite the broad range of useful HIV prevention tools and methods, and the success factor that the new infections among adults have declined by an estimated 16%, from 1,9 million [1,5 million-2,5million] to 1,6 million [1,3 million-2,1 million] in 2017 [2]. HIV prevalence continues to rise. During the early days of the HIV epidemic (from 1988 to 1996), the HIV prevention efforts were mainly focusing on primary prevention to decrease HIV risk behaviours among uninfected individuals. HIV prevention interventions ranged from diagnosis and treatment of sexually transmitted infections to HIV education, condom social marketing, policy dialogue, and legal protection for people living with HIV and vulnerable groups. [28]

However, the global HIV policymakers began to recognize the importance to re-examine the theories and models of behavioural change. Nowadays, national HIV/AIDS strategies are mainly focusing on a combination of primary and secondary prevention

approaches. Secondary prevention strategies are designed to reduce sexual risk behaviour among people living with HIV/AIDS (PLWHA) and take societal conditions (gender inequalities, sexual cultures, poverty, and access to HIV services) into consideration. [29]

In order to achieve lasting impact on reducing HIV incidence and to improve the well-being of affected communities around the world, the UNAIDS defined a combination prevention meaning and a framework for planning, implementing and monitoring HIV prevention programs.

The UNAIDS Prevention Reference Group defined in December 2009 a term "combination prevention" as following [27]:

Combination prevention programmes are rights-based, evidence-informed, and community-owned programmes that use a mix of biomedical, behavioural, and structural interventions, prioritized to meet the current HIV prevention needs of particular individuals and communities, so as to have the greatest sustained impact on reducing new infections. Well-designed combination prevention programmes are carefully tailored to national and local needs and conditions; focus resources on the mix of programmatic and policy actions required to address both immediate risks and underlying vulnerability; and they are thoughtfully planned and managed to operate synergistically and consistently on multiple levels (e.g. individual, relationship, community, society) and over an adequate period of time. They mobilize community, private sector, government and global resources in a collective undertaking; require and benefit from enhanced partnership and coordination; and they incorporate mechanisms for learning, capacity building and flexibility to permit continual improvement and adaptation to the changing environment.

The following Figure 1. is an UNAIDS framework that illustrates how intervention strategies are advised to work together. The national strategic plans should identify the connecting points between HIV prevention, treatment, care and support services that are recognized through a local prevention analysis.

Biomedical intervention strategies to reduce exposure, transmission and/or infection
Male and female condom provision
Drug treatment including opioid substitution therapy, needle and syringe provision
Male circumcision
Biomedical prophylaxis - ARVs in PMTCT services, post exposure prophylaxis etc
Appropriate and accessible STI services, ART for prevention
Blood safety, standard precautions in health care setting
Behavioral intervention strategies to promote individual risk reduction
HIV testing and risk reduction counselling
Behavioral change communication to promote partner reduction, condom use, uptake of HIV testing and counselling
HIV education
Interpersonal communication, including peer education and persuasion
Social marketing of prevention commodities
Cash incentives for individual risk avoidance
Social and cultural intervention strategies
Community dialog and mobilisation, to demand services; for AIDS competence
Stigma reduction programmes
Advocacy and coalition building for social justice
Media and interpersonal communication to clarify values, change harmful social norms
Education curriculum reform, expansion and quality control
Support youth leadership
Political, legal and economic strategies
Human rights programming
Prevention diplomacy with leaders at all levels
Community microfinance/microcredit
Training/advocacy with police, judges
Policies re-access to condoms (schools, prisons)
Review and revise workplace policies
Stakeholder analysis & alliance building
Strategic advocacy for legal reform
Regulation/deregulation, taxes
Intervention strategies addressing physical environment
Housing policy and standards
Enhance farming, other modes of subsistence, for food security
Infrastructure development - transportation, communications

Figure 1. The UNAIDS framework for HIV prevention interventions

The Estonian national HIV/AIDS strategy on prevention, treatment, and care for 2017-2025 has been conducted to follow the UNAIDS framework for combining prevention interventions. In 2017, the Estonian Ministry of Social Affairs together with the

HIV/AIDS sector's stakeholders, described four main focus areas to tackle the HIV epidemic in Estonia.

Focus areas and activities are the following [30]:

1. HIV testing and diagnosis;
2. Activities for people living with HIV/AIDS:
    a) HIV treatment and care;
    b) Preventing co-infections;
3. HIV infection prevention:
    a) HIV prevention among most-at-risk populations;
    b) stigma and discrimination;
    c) prophylaxis preventions;
4. Monitoring and evaluation.

The Estonian national HIV/AIDS strategy is mainly focusing on biomedical intervention strategies to reduce exposure, transmission and/or infection (male and female condom provision, drug treatment including opioid substance therapy, needle and syringe provision, biomedical prophylaxis - ARVs and PMTCT services, post-exposure prophylaxis, appropriate and accessible STI services, blood safety), behavioural intervention strategies to promote individual risk reduction (HIV testing and risk reduction counselling, behaviour change communication to promote partner reduction, condom use, uptake of HIV testing and counselling, HIV education), and on social and cultural intervention strategies (stigma reduction programs).

HIV testing is considered to be the gateway to HIV prevention, treatment, care, and other supportive services. As Walensky et al. (2011) stated in her article *"Whatever the next hottest, scientifically proven HIV treatment or prevention strategies are, they will share a common denominator for implementation: the HIV test."* [31].

2.2.1 HIV testing as a prevention strategy

Many international frameworks, guidelines, and reports are suggesting to prioritize the uptake and effectiveness of HIV testing [32] [30] [7] [8] [5]. HIV testing services are usually containing the following services: counselling (pre-test information and post-test counselling); linkage to appropriate HIV prevention, treatment and care; coordination with laboratory services to support quality assurance and the delivery of accurate results [33]. Therefore, to gain the best results from other interventions (pre-exposure prophylaxis or taking ARVs to improve an individual's clinical outcomes), individuals have to know their HIV status.

HIV testing and counselling (HTC) is the most crucial first step in supporting people with HIV to know their status and gain sufficient results from HIV prevention, treatment and care services. For those who test negative, the provision of HIV test offers the opportunity for preventive education and may also lead to behavioural changes. For example, people who find out they are not HIV infected may start using condoms and start thinking about their sexual risk behaviour [34]. For those who test positive, the provision of a test will raise the chance to link and enrol patients into HIV clinical care.

Most European countries are recommending risk-factor-based HIV testing, where physicians offer HIV tests at the patient's request or when a physician finds that the patient might be in a key population group.

World Health Organization is suggesting to focus on five key population groups [33]:

1. people who inject drugs;
2. sex workers;
3. men who have sex with men;
4. people in prisons and other closed settings and
5. transgender people.

The Estonian HIV testing guideline and the national HIV/AIDS strategy is focusing on the first four key population groups. In Estonia, the HIV prevalence among people who

inject drugs is estimated to be at 48-66% based on several studies conducted by the Estonian National Institute for Health Development (ENIHD) [35] [36] [37]. The average HIV prevalence among sex workers is estimated to be approximately 8-13% in Estonia (studies were done in 2011 [38] and 2016 [39]). It is projected that the prevalence among men who have sex with men is approximately 4% in Estonia in 2016 [30]. In 2017 approximately 14% of people in prisons were HIV positive [30].

The United States [40] [41] and France [42] HIV testing guidelines are suggesting to test all adults who have had contact with the healthcare system at any given time, but this method is not feasible and cost-efficient for most of the European countries. Therefore, majority of European HIV testing guidelines are strongly recommending targeted HIV testing approaches based on key population groups and emphasizing the need to suggest HIV tests for patients who present to healthcare settings with indicator conditions [7] [3] [32] [8] [9]. The HIDES Study Group together with the European Centre for Disease Prevention and Control (ECDC) agency stated in their feasibility study that indicator condition guided HIV testing is an acceptable, feasible, and effective strategy to address the on-going HIV epidemic in Europe. Thus, the indicator-condition guided testing strategy has been incorporated into the Estonian HIV testing guideline since 2012. Although the guideline suggests testing key populations and patients with indicator conditions, the latest studies done in Estonia confirm that many HIV-infected patients make numerous visits to healthcare services before being tested. The Estonian National Institute for Health Development published a nation-wide article, where 443 (82%) of new HIV cases had visited healthcare services at least once in the 2 years before HIV diagnosis, and the mean number of their visits was 9,1. 71% had visited their general practitioner at least once, but only 3% of them had been tested for HIV, which is meagre testing rate because it is free of charge for patients and general practitioners do not have any financial restrictions to suggest an HIV test.

This research paper aims to identify and examine general practitioners' barriers and facilitators towards provider-initiated HIV testing methods as primary health care level is the most visited healthcare setting for patients in many countries [14] [43] and provides considerable potential for earlier diagnosis.

2.3 General practitioners' barriers and facilitators towards provider-initiated HIV testing strategies and digital reminders

The majority of HIV testing guidelines are recommending mix-methods for HIV testing and counselling. World Health Organization recommends a combination of client-initiated HIV testing method combined with provider-initiated HIV testing strategies to reduce the number of late diagnosis and missed opportunities. [44]

Available literature shows that patient-related barriers, such as not acknowledging that they are at risk, fear of legal consequences of positive testing and lacking information about the HIV testing and diagnosis, might be addressed when improving the quality of HIV testing and counselling, enhancing access to evidence-based HIV prevention and making social and legal environments supportive. [44]

Dominguez-Berjon et al. (2017) described in their article that 80% of their study population agreed to make an HIV test [45]. Roy et al. (2009) stated the patients HIV tests uptake rate was 96% [9]. Therefore, if a physician explains the HIV test's necessity, the majority of patients will accept the test.

Thus, it is essential to focus on the provider-initiated HIV testing strategies and explore the barriers and facilitators general practitioners and primary care providers are facing.

Joore et al. (2017) argued in the article, that the main barriers general practitioners are confronting can be divided into 3 categories [46]:

1. Content-related barriers: doubts about the right target groups, evidence-based scientific basis for the indicator condition selection, other issues in primary care centres are more important

2. Organisational barriers: discussing an HIV test is time-consuming, offering HIV tests for new patients registering at their centres is inappropriate, general practitioners felt unsure when to repeat the HIV test

3. Patient-related barriers: patients will refuse to take an HIV test, worried about judging their patients' sexual behaviour, indicator condition-guided testing might bring up unnecessary fear among patients

Other authors have stated similar findings on HIV testing barriers. Loos et al. (2014) conducted a study, where 65 general practitioners discussed their barriers for suggesting HIV tests. The main findings were general practitioner's personal discomfort to discuss HIV topic, worries about the stigma and the fear of negative affect to provide HIV test proactively. Many of the general practitioners mentioned in the study, that they are overloaded with other preventive measures and lack of time forces to prioritise tasks they are focusing on [47]. Deblonde et al. (2018) made a systematic review about the barriers and facilitators general practitioners face, as most of the tests are still carried out based on patient's request. Barriers reviewed are largely overlapping with the previously cited studies. In addition to previous studies, this systematic review covered additional barriers such as lack of communication skills on sexual health, lack of knowledge about testing recommendations and lack of knowledge to deliver the results [48].

The same systematic review pointed out the main facilitators that can improve testing and awareness about the HIV epidemic among general practitioners. One of the fundamental facilitators is evidence-based knowledge sharing and trainings on HIV epidemic and testing recommendations, sharing estimates of undiagnosed HIV prevalence, defining time to test key populations and developing practical tools that enable to identify people at high risk of acquiring HIV infection [48].

Thornton et al. (2012) explored health care staff attitudes towards the routine HIV testing in non-traditional settings and one of the results was pointed out as a facilitator for targeted testing. More precisely, doctors mentioned that they would agree to make more HIV tests with the certain amount of resources (time and money wise) if the target group would be pre-selected based on clinical indicators [49].

One of the options to pre-select patients is focusing on the indicator condition-guided HIV testing approach. In an article written by Joore et al. (2017), GPs mentioned that the list of indicator conditions is too long to remember and the electronic clinical reminder systems in the electronic medical records could be the solution to remember and suggest HIV tests for patients most at risk [46].

In the next chapter, one of the facilitators will be analysed, and according to the aim of the study, the clinical decision support tool was selected.

2.4 Clinical decision support tools and electronic medical record-based reminders in primary care to enhance HIV indicator condition-guided testing

Computerised reminders and clinical decision support systems have been evaluated in numerous studies and systematic reviews. Studies have compared pretest and posttest outcomes and effectiveness results, but there are still relatively few studies that are highlighting the need to explore the technical features of the clinical decision support system and identifying what are the key factors for significant improvements in clinical practice. Kawamoto et al. (2005) published a categorisation for clinical decision support systems associated with improved clinical practice and their technical features. The following list contains features that are independent predictors of system effectiveness by the primary meta-regression analysis conducted by Kawamoto. The primary analysis claimed system effectiveness predictors to be the automatic provision of decision support as part of the clinician workflow, provision of decision support at time and location of decision making, provision of recommendations rather than just an assessment and computer-based generation of decision support.

In this research, the author is focusing on HIV specific clinical decision support systems and their main success factors and clinical outcomes.

Avery et al. (2013) implemented an electronic medical record-based reminder to alert primary care providers about the absence of an HIV test. The study group consisted of 425 627 outpatient visits and study reported a significant increase in HIV testing. HIV test rates increased nearly four-fold (before the intervention testing rate mean=4,3% and after the intervention mean=17,3%) [50].

Chadwick et al (2016) presented their study findings where they implemented real-time HIV prompts in a large London hospital and a primary care centre. At the end of the study, they found that using an HIV CDSS appears to be feasible and acceptable for health care providers and increases 6% of test rates. Furthermore, they did interviews with general practitioners, who claimed that electronic prompts helped them to consider

HIV tests as more routine and less sensitive, as the indicator condition based testing approach does not require a lifestyle discussion, then a prompt permits to raise a topic on a neutral basis [51].

The latest researches are showing similar results in primary care level. Redondo et al. (2019) made a prospective interventional study where they integrated HIV suggesting prompts into general practitioners' medical programmes and assessed the impact of requested HIV tests. The study group consisted of 832 patients with an indicator condition. The number of HIV tests requested based on indicator conditions increased from 12,6% to 35,6% and fell to 17,9% after removing prompts. 4 HIV infections were diagnosed during the intervention phase [52].

Previously described studies are confirming Kawamoto's arguments, that the clinical decision support system can have significant outcomes when it provides decision support at time and location of decision making, it is combined into daily practice and workflows and it will provide recommendations for the next steps. It is important to notice, that all of the above-mentioned studies integrated a prompt solution into already existing medical software products and executes an electronic medical health record analysis behind the scenes, not forcing health care providers to think about the HIV topic when it is not relevant.

3 Methodology

The research strategy that will be used in this pilot study is a quasi-experimental design. Quasi-experimental design or in other words, pre-post intervention design is a commonly used research strategy in medical informatics. Quasi-experiments are studies that are focusing on evaluating the benefits of specific interventions but do not use randomisation. The chosen method is frequently compared to randomised trials as they both are aiming to show causality between an intervention and an outcome [53]. Using a randomised controlled trial design is widely accepted, and the method has the highest level of credibility. Although in medical informatics, it is technically challenging to randomize subjects and chosen groups. Therefore, the quasi-experimental design is preferred.

According to Harris et al. (2006) article, this research paper is more precisely using a design that is defined as *the one-group pretest-posttest design.* This approach is widely used when a new technology or a new software product is introduced as an intervention. The selected research strategy allows analysing outcomes before the intervention and compare the outcomes after the intervention. Reproducing the same intervention to different groups at multiple times, which gives an essential value for the validity [53].

Goetz et al. (2008) article describes the quasi-experimental design as one of the strengths of their study. It allows conducting a real-world effectiveness study that examined the impact of their intervention. Goetz et al. (2008) article and this research paper are similar in terms of structure and study design [16].

As an intervention, this research is focusing on implementing indicator condition-guided HIV testing strategy combined with HIV decision-support system in primary health centres in Estonia. The intervention group involves 3 primary health centres with 10 general practitioners' practice lists.

To gain meaningful insights about the main barriers and facilitators to use HIV clinical decision support system, the author conducted an online questionnaire. The questionnaire answers are mainly analysed for qualitative purposes, and participants' answers are used for supporting quantitative results.

3.1 Data collection

3.1.1 Study design, settings, population, and ethical approval

The research study was conducted between 15. October 2018 and 15. April 2019 in 3 primary health centres providing care to 18 640 patients in Tallinn. Primary health centres were selected based on centres' management acceptance, willingness to use innovative technologies and location (Tallinn was selected as an example of an HIV epidemic area in Estonia) to cover geographically crucial areas.

Selected primary health centres were the following:

1. Jürgenson PAK OÜ
2. Merekivi perearst OÜ
3. Pirita-Kose perearstikeskus OÜ

Patients were eligible for this study when they met the following criteria:

1. Age above 18-years-old (included)
2. Age below 65-years-old (included)
3. One of the HIV indicator conditions diagnosed (List of indicator diseases included is shown in Appendix 1.)
4. Had an appointment with their GP within the 6-month study period (15. October 2018- 15. April 2019)
5. Signed informed consent

Patients were excluded from the study when they met the following criteria:

1. Age below 18-years-old
2. Age above 65-years-old
3. Previous HIV or AIDS diagnoses

All the above-mentioned primary health centres got a software update (15. October 2018), including the new analytical algorithms to detect HIV indicator conditions.

The experimental study received a formal ethical approval (decision number 2324, 17.05.2018) from Tallinn Medical Research Ethics Committee. All patients signed an informed consent form (Consent form in Estonian shown in Appendix 2) before taking part in the study. HIV tests were done by the GPs or family nurses even when the patient did not want to participate in the on-going study but was willing to make an HIV test.

3.1.2 Technical software, medical health records, and HIV clinical decision-support system

All the primary health centres that were included in the study intervention group are using Medisoft OÜ "Perearst2" medical software. Perearst2 is a widely used medical software among general practitioners in Estonia. Almost 85% of Estonian general practitioners are using the software. It contains patients' medical health records, including their laboratory test results, diagnosis, free text for anamnesis and it is integrated with Estonian National Health Information System.

This research implemented a real-time, automated, electronic clinical reminder into Perearst2 software to identify patients who are in a risk group based on previously diagnosed HIV indicator conditions. Clinical reminder suggested to offer HIV testing and listed an indicator condition why the reminder was triggered. The reminder was resolved when a doctor either ordered an HIV test or specified that the patient refused to make an HIV test or participate in the study. Once resolved, the reminder was no longer triggered.

The clinical reminder system is provided by Diagnostic Match OÜ and all the diagnosis that are included are validated by the Estonian Family Doctors' Association and by the HIV in Europe initiative, who published the HIDES (HIV Indicator Diseases across Europe Study).

Example of the clinical reminder is shown in Figure 2 "HIV CDSS reminder for making an HIV test".

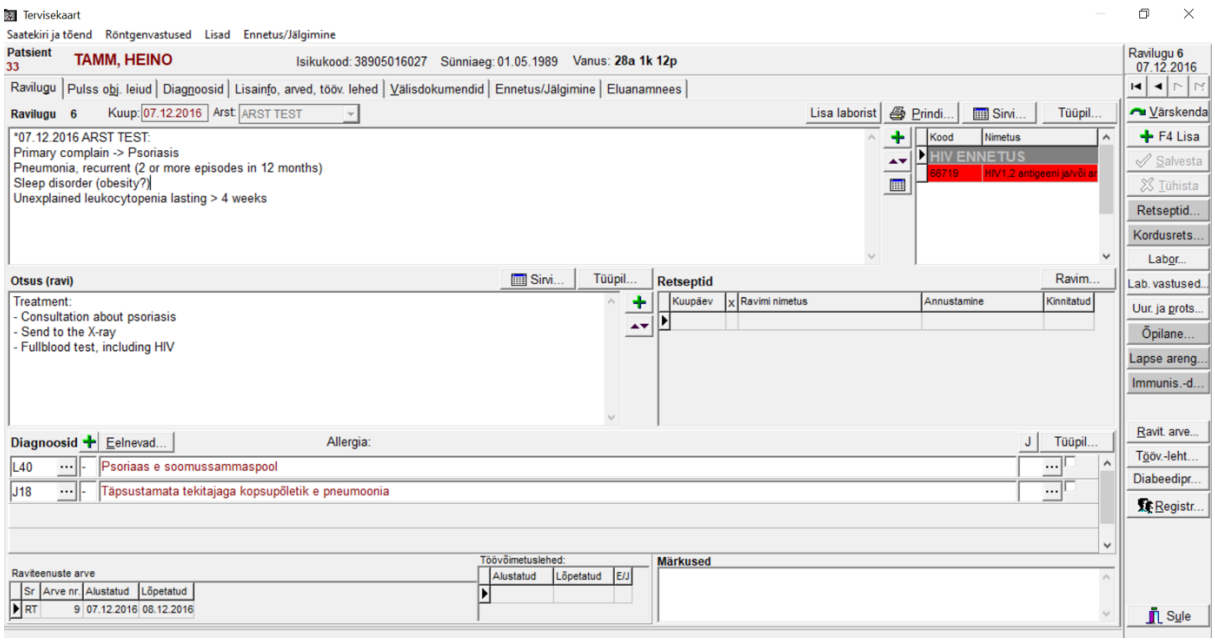

Figure 2. Example of the reminder "HIV prevention: HIV CDSS reminder for making an HIV test"

3.1.3 Online questionnaire for the intervention participants

The author of this research used a qualitative approach to get a comprehensive overview about the Estonian general practitioners' and family nurses' viewpoints about the HIV indicator condition guided testing approach and the use of digital reminders in their everyday practice.

In most medical guidelines, provider-initiated HIV testing approach is recommended, but the implementation has not been successful. In Estonia, HIV testing medical guideline was published in 2012, but the HIV testing rates done in primary care level, is still considered very low even though there are no financial barriers for general practitioners to make HIV tests. Thus, there is a great need to understand the barriers and possible facilitators.

The online questionnaire was sent out in May 2019. The questionnaire was done using Google Forms platform and involved four main topics:

1. Characteristics of participants

2. HIV indicator condition-guided testing approach as a clinical method
3. HIV clinical decision support tool as a technical solution
4. Discussion and reflection on the pilot study

All the questions and answers were written in Estonian (see Annex 3 for original version) and the translated version of the questionnaire is described in Table 2.

3.1.4 Pilot study process

This research follows the process described below:

1. Patients were eligible if they visited their GPs during the study period.
2. When a patient had an indicator condition diagnosed, a doctor got a clinical reminder to suggest HIV testing. Clinical reminder was sent out at the same second, when a doctor opened patient's medical record.
3. A doctor informed a patient about the on-going study and made a pre-test counselling.
4. The patient had to sign an informed consent form to be fully eligible (form included demographical information and a written signature).
5. HIV test was provided, and post-test counselling was performed by the specialized health care professional
    a. If the test result was negative - the family nurse informed a patient
    b. If the test result was positive - general practitioner's appointment had to be scheduled
6. After the second appointment, the patient will be referred immediately to visit the infectious disease doctor where new analyses are performed, and the diagnosis confirmed.

7. After the pilot study phase, the online questionnaire was sent out for the participants. Findings are compared to gain insights about how efficient IC-guided HIV testing strategy is in Estonian primary care level and how much automated algorithms can influence the efficacy.

3.2 Data analysis

The aim of data analysis was to evaluate the impact of digital reminders in Estonian primary health centres by comparing pre- to post-intervention periods and changes in the rate of HIV tests. In addition to analysing the quantitative data, the author of this research used the qualitative method - online questionnaires - to explore healthcare professionals' viewpoints about the HIV indicator condition-guided testing strategy and the use of digital reminders.

This research paper aims to address the following research questions:

The prevalence of HIV indicator conditions and HIV testing in primary health centres:

1. Which HIV indicator conditions were mostly diagnosed and treated in primary health centres?

2. Which HIV indicator conditions are not treated nor diagnosed in primary health centres?

3. Which HIV indicator conditions led to suggesting HIV testing?

4. How many HIV tests were carried out 6 months before starting with the intervention in primary health centres?

5. How many HIV tests were carried out during the intervention?

The diagnosis and e-referrals from GPs to infectious disease doctor:

1. How many patients got an e-referral to infectious disease doctor?

2. How many patients got the HIV diagnosis?

Patients' acceptance of participating in the study and taking an HIV test:

1. What is the percentage of acceptance to participate in the study group but declined taking an HIV test?

2. What percentage of patients accepted to take an HIV test but declined to participate in the study?

3. What were the main reasons for declining an HIV test or participating in the study?

GPs' attitude and usage of the HIV DSS:

1. What kind of feedback was provided for the HIV DSS by the GPs?

2. How well did they manage to update their medical platforms to use the HIV DSS solution?

3. What were the main barriers to using HIV DSS?

4. What were the main facilitators for using HIV DSS?

5. How many digital reminders were declined and what were the reasons?

The first three themes were categorized and analysed by using SPSS Statistics software and descriptive statistics. GPs' attitude and usage of the HIV DSS theme was covered by analysing online questionnaires.

For better data analysis, the author of this research, made an Excel sheet for every primary health centre to gather patients' health data anonymously and in a structured manner. For better overview see Table 1.

The Excel sheet primary health centres had to fill out were divided into 5 categories:

Category	**Group**	**Data field**	**Data descriptions and Definitions**
Background information	ID code and Pilot Study code	TEXT	1. <ID code> = ID codes were decoded to get patients' sex and age 2. <Pilot Study code> = Pilot Study code was

			assigned to every patient to keep patients' health data secured
	Labour force	SELECT	<labour force> = 1. **Employed** = a person who during the reference period - worked and was paid as a wage earner, entrepreneur or a freelancer; - worked without direct payment in a family enterprise or on his/her own farm; - was temporarily absent from work. 2. **Unemployed** = a person who fulfils the following three conditions: - he or she is without work (does not work anywhere at the moment and is not temporarily absent from work); - he or she is currently (in the course of two weeks) available for work if there should be work; - he or she is actively seeking work. 3. **Inactive** = a person who do not wish or are not able to work - studying - ill or disabled - taking care of children or other family members - retirement-age - discouraged persons (lost hope to find work)
	Education	SELECT	<education> = 1. General education (basic school level, 6 grades) 2. General education (basic school level, 9 grades) 3. Vocational courses with no previous education requirements 4. Gymnasium level 5. Vocational courses after basic education 6. Vocational courses after secondary education 7. Professional higher education 9. Bachelor study 10. Master's study 11. Doctoral study
	Nationality	SELECT	<nationality> = 1. Estonian 2. Russian 3. Other
	Appointment time	DATE	<appointment time> = date, when the patient visited primary health centre
Previously diagnosed HIV indicator conditions	Indicator conditions and Date	TEXT + DATE	1. <indicator conditions> = ICD-10 code, why the HIV CDSS reminder was triggered 2. <date> = when the indicator condition was diagnosed
Pilot study	Patient agreed to participate in the pilot study	SELECT	YES/NO options

	Patient agreed to make an HIV test	SELECT	YES/NO options
	Patient disagreed to participate in the pilot study, but agreed to make an HIV test	SELECT	YES/NO options
HIV testing	Date, when the HIV testing was carried out	DATE	Date, when the HIV test was taken
	HIV test result	SELECT	1. Positive 2. Negative 3. Invalid result
HIV diagnosis	Confirmed HIV diagnosis by the infectious disease doctor	SELECT	YES/NO options

Table 1. Pilot Study's data analysis concept and data categories

Online questionnaire had the same overall analysis approach and was divided into 4 categories. See Table 2. for the detailed overview.

Category	**Question**	**Data field**
Characteristics of participants	Name of the Primary Health Centre (where I work)	TEXT
	I am a: 1. General practitioner 2. Family nurse 3. Resident	RADIO
HIV indicator condition-guided testing approach as a clinical method	Were you aware of the HIV indicator condition-guided testing method before participating in the pilot study? 1. Yes 2. No 3. Other: please specify	RADIO
	Were you aware of the Estonian HIV testing guideline that was published in 2012? 1. Yes 2. No 3. Other: please specify	RADIO
	Do you consider HIV indicator condition-guided testing as an evidence-based method? 1. Yes 2. No 3. Not sure 4. Other: please specify	RADIO
	If you answered "No" or "Not sure" in the previous	TEXT

	question, please explain why	
	Do you believe the indicator condition-guided testing method fits well into the daily workflow of Estonian general practitioners and family nurses? 1. Yes 2. No 3. Not sure 4. Other: please specify	RADIO
	If you answered "No" or "Maybe" to the previous question, please explain the main barriers that would prevent using the method in the Estonian primary care level?	TEXT
	Please explain which facilitators would help to implement the HIV indicator condition-guided method?	TEXT
	Do you think HIV indicator condition-guided testing method could be used as one of the metrics for primary health care quality system? 1. Yes 2. No 3. Not sure 4. Other: please specify	RADIO
	If you answered "No" to the previous question, please explain your choice	TEXT
HIV clinical decision support tool as a technical solution	Would a digital reminder in Perearst2 medical software help the implementation of HIV indicator condition-guided testing in the primary care level? 1. Yes 2. No 3. Not sure 4. Other: please specify	RADIO
	If you answered "Yes" to the previous question, then which goals or benefits does the automatic indicator condition reminders' carry? 1. Increase of the clinical quality 2. Increase of the service quality 3. To find undiagnosed patients 4. To enhance the co-operation between specialists and general practitioners 5. Increase of the patients' satisfaction 6. Increase of the patients' awareness about the HIV infection 7. Better prevention 8. Don't know	CHECKBOX
	If you answered "No" to the previous question, please explain the barriers or problems that are caused by technical diagnosis algorithms 1. Takes too much time	CHECKBOX

	2. Requires too many changes in the current workflows 3. Digital reminders disturb my workflow 4. I don't trust digital reminders and I'd like to decide myself to whom I suggest HIV testing 5. Don't know	
	Did you ignore any of the HIV digital reminders in the software? 1. Yes 2. No 3. Not sure 4. Other: please specify	RADIO
	If you answered "Yes" to the previous question, please explain the main reasons for ignoring the reminders	TEXT
Discussion and reflection on the pilot study	If you wish, you can share your experience about participating in the pilot study (if and how difficult was patient counselling; how difficult was to recruit patients to the pilot study; how the patients reacted when they were suggested to take an HIV test; id and how could we make the algorithms and reminders better; if and how could we enhance the organisational processes to make sure the algorithm is most valuable)	TEXT

Table 2. Online questionnaire layout for the Pilot Study participants

4 Results

This chapter describes the results of the pilot study described in Chapter 3. The research results' chapter will concentrate on two study methods - pilot study carried out by the primary health centres and the qualitative online questionnaire as the complementary data for the analysis.

The objectives of this research paper are to:

1. *Analyse* HIV indicator conditions prevalence in the Estonian primary care level.

2. *Compare* two different HIV testing strategies: HIV indicator condition-guided HIV testing strategy with current everyday practice.

3. *Evaluate* the impact of digital reminders in primary health centres (using HIV DSS).

4. *Integrate* HIV DSS algorithms into general practitioners' medical platform to measure its feasibility and the readiness to use it by the GPs.

To combine the aim and objectives of this paper, the results will be divided into following sub-chapters:

1. The prevalence of HIV indicator conditions and HIV testing in primary health centres;
2. Patients' acceptance of participating in the study and taking an HIV test;
3. GPs' attitude towards provider-initiated HIV testing strategy and indicator condition-guided HIV testing method;
4. Primary healthcare providers' barriers and facilitators to use the HIV CDSS.

4.1 The prevalence of HIV indicator conditions and HIV testing in primary health centres

4.1.1 Primary health centres' characteristics

The pilot study included 3 primary health centres that are located in Tallinn and providing care for almost 18 640 patients (17 162 insured patients by the Estonian Health Insurance Fund). Table 3 provides centres' information in more detail.

Characteristics				Age groups (in years)				
Primary health centre	**GP's practice list ID-code**	**Patients number in GP's practice list (01.01.2019)**	**Insured patients (01.01.2019)**	**0-3**	**3-7**	**7-50**	**50-70**	**70+**
Jürgenson PAK OÜ	N0152	1961	1674	95	85	1186	236	72
	N0217	1972	1851	102	132	1046	336	235
	N0833	1833	1675	149	208	1166	126	26
	TOTAL	**5766**	**5200**	**346**	**425**	**3398**	**698**	**333**
Merekivi perearst OÜ	N0064	1938	1807	86	100	1211	317	93
	N0066	1881	1771	56	79	1186	335	115
	N0067	1959	1826	69	119	1264	287	87
	N0820	1956	1840	108	156	1267	206	103
	TOTAL	**7734**	**7244**	**319**	**454**	**4928**	**1145**	**398**
Pirita-Kose perearsti-keskus OÜ	N0105	1702	1538	149	113	803	366	107
	N0206	1712	1596	61	104	966	318	147
	N0804	1723	1584	78	131	977	243	155
	TOTAL	**5137**	**4718**	**288**	**348**	**2746**	**927**	**409**

Table 3. The overview of the general practitioners' practice lists (Data: from Estonian Health Insurance Fund, 01.01.2019)

The Estonian Health Insurance Fund is covering approximately 94% of the population's health care services. Thus, there are no financial barriers for patients nor primary health centres to suggest or to make an HIV test. Making an HIV test for both parties is free of charge and fully covered. In Estonia, there is a universal agreement that uninsured people can also receive HIV tests free of charge in special anonymous clinics, during an appointment with general practitioners or specialists or in youth counselling centres. Uninsured people are commonly 20-59-year-old men, who are long-term unemployed or who work unofficially [11]. Less than 10% out of all the patients in 3 primary health centres were uninsured, but none of the uninsured patient had an appointment with their

general practitioners or family nurses during the study period with signed informed consent to participate in a pilot study.

Most of the centres' patients are in an age group of 7-50-years (58,2% - 68%) and an age group of 50-70-year-old patients are the second segment of patients (covering 13,4% - 19,6%). In this research study, the age group of 18-65-year-old was included based on previously done international research and recommendations given in medical guidelines [54] [30] [32] [55]. The next chapter will provide more characteristics about the patients, who attended primary health centres during the intervention period (15. October 2018 – 15. April 2019).

4.1.2 Patients' characteristics

During the 6-month period when the HIV CDSS was running in 3 primary health centres, 268 patients had an appointment with their general practitioners or family nurses and had at least one of the HIV indicator condition diagnosed before.

There were 8 patients unidentified or their informed consent was not signed, and 8 patients declined to participate in the pilot study. The eligible study population consisted of 252 patients. Table 4 illustrates patients' characteristics.

Primary health centres	**Jürgenson PAK**		**Merekivi perearstid**		**Pirita-Kose perearstikeskus**	
	N	%	N	%	N	%
Total study population	**62**	**25**	**122**	**48**	**68**	**27**
Gender						
Male	20	32	29	24	21	31
Female	42	68	93	76	47	69
Age at index date						
18 to 39 years	27	44	48	39	33	49
40 to 49 years	21	34	39	32	19	28
50 to 59 years	13	21	27	22	9	13
60 years and older	1	1	8	7	7	10
Labour force						
Employed	56	90	113	93	57	84
Unemployed	3	5	0	0	5	7
Inactive	3	5	9	7	6	9
Education						

General education (basic school level, 6 grades)	0	0	0	0	0	0
General education (basic school level, 9 grades)	1	2	9	7,3	3	5
Vocational courses with no previous education requirements	0	0	1	0,8	0	0
Gymnasium level	9	15	18	15	11	16
Vocational courses after basic education	3	5	4	3,3	5	7
Vocational courses after secondary education	4	6	14	11,5	4	6
Professional higher education	10	16	9	7,3	7	10
Bachelor study	13	21	44	36	21	31
Master's study	22	35	22	18	17	25
Doctoral study	0	0	1	0,8	0	0
Nationality						
Estonian	51	82	105	86	54	80
Russian	10	16	17	14	12	18
Other	1	2	0	0	1	2

Table 4. Characteristics of the eligible patients on 3 primary health centres, (N=525)

Almost half of the patients (48%) had their appointments in Merekivi perearstid OÜ primary health centre, 25% of patients visited Jürgenson PAK OÜ and the other remaining part of the study group had appointments in Pirita-Kose perearstikeskus OÜ. The majority (68%-76%) of participants were female patients. The median age was 42 and almost 90% of participants were employed with the exception of Pirita-Kose perearstikeskus where the employment percentage was 84. Approximately 80% of the study group were Estonians and more than 60% had received higher education (professional higher education, bachelor study, master's study or doctoral study).

4.1.3 HIV indicator conditions

The pilot study's automated algorithms (HIV CDSS) included all the indicator diseases defined in HIV Indicator Diseases Across Europe Study (HIDES) and in a HIV in Europe guidance for implementing HIV testing in adults in health care settings [5]. The aim was to compare Estonian local recommendations for indicator condition-guided HIV testing strategy against the European suggestions. Table 5 shows the prevalence of HIV indicator conditions in the Estonian primary care level and a comparison of two different diagnosis lists (local versus European recommendations). All the indicator conditions are diagnosed in the primary care level and covered financially by the Estonian Health Insurance Fund.

Conditions that are considered as indicators can be divided into 3 categories based on their prevalence and correlation between an undiagnosed HIV. The Table 5 illustrates the prevalence of HIV indicator conditions diagnosed and treated in 3 primary health centres. Furthermore, the Table 5 demonstrates the comparison of local clinical recommendations against European HIDES suggestions [5]. HIV indicator conditions listed in a Table 5 were the basis to trigger the digital reminders in the pilot study and the categorisation is based on HIDES study.

32 patients (13%, N=252) had at least 2 HIV indicator conditions diagnosed, and 6 patients (2%, N=252) had 3 indicator conditions diagnosed beforehand. For the better data analysis, the author of this research included only one of the diagnosis into the Table 5. The inclusion was based on a clinical relevance and the diagnosis had to have higher prevalence according to HIDES study.

1. Conditions which are AIDS defining among people living with HIV				
ICD-10 code	Diagnosis	n	% (N=252)	Included in the local medical guideline [10]
A60.0	Anogenital herpesviral infection	2	0,8	Yes
J15	Bacterial pneumonia, not elsewhere classified	3	1,2	Yes
I41.0	Myocarditis tuberculous	4	1,6	Yes
	TOTAL	**9**	**3,6**	
2. Conditions associated with an undiagnosed HIV prevalence of >0,1%				
A54.0	Gonococcal infection of lower genitourinary tract without periurethral or accessory gland abscess	1	0,4	Yes
A56.0	Other sexually transmitted chlamydial	4	1,6	Yes

	diseases			
A59	Trichomoniasis	1	0,4	Yes
A63.8	Other specified predominantly sexually transmitted diseases	7	2,8	Yes
B02	Herpes zoster	17	6,7	Yes
B02.9	Zoster without complication	9	3,6	Yes
B16	Acute Hepatitis B	1	0,4	Yes
B18.2	Chronic viral hepatitis C	5	2	Yes
B27	Infectious mononucleosis	5	2	Yes
B27.0	Gammaherpesviral mononucleosis	1	0,4	Yes
B27.1	Cytomegaloviral mononucleosis	2	0,8	Yes
B27.9	Infectious mononucleosis, unspecified	5	2	Yes
D72.8	Other specified disorders of white blood cells	1	0,4	Yes
J18.9	Pneumonia, unspecified + recurrent	14	5,6	Yes
L21	Seborrhoeic dermatitis	12	4,8	Yes
L21.8	Other seborrhoeic dermatitis	6	2,3	Yes
L21.9	Seborrhoeic dermatitis, unspecified	6	2,3	Yes
R50.9	Fever, unspecified	18	7,1	No
	TOTAL	**115**	**45,6**	
3. Other conditions considered likely to have an undiagnosed HIV prevalence of 0,1%				
B37	Candidiasis	63	25	Yes
B37.0	Candidal stomatitis	3	1,2	Yes
B37.2	Candidiasis of skin and nail	3	1,2	Yes
B37.3	Candidiasis of vulva and vagina	32	12,7	Yes
B37.4	Candidiasis of other urogenital sites	3	1,2	Yes
L40	Atypical psoriasis	22	8,7	Yes
R63.4	Abnormal weight loss	2	0,8	No
	TOTAL	**128**	**50,8**	

Table 5. Distribution of HIV indicator conditions identified by the digital reminder, (N=252)

The most frequently identified indicator conditions were candidiasis (B37; 25%), candidiasis of vulva and vagina (B37.3; 12,7%), atypical psoriasis (L40; 8,7%), unspecified fever (R50.9; 7,1%), herpes zoster (B02; 6,7%), unspecified pneumonia (J18.9; 5,6%), seborrhoeic dermatitis (L21; 4,8%), zoster without complications (B02.9; 3,6%) and other specified predominantly sexually transmitted diseases (A63.8; 2,8%).

50,8% (n=128; N=252) of all the indicator diseases were categorised under third group (other conditions considered likely to have an undiagnosed HIV prevalence of 0,1%) and 45,6% (n=115; N=252) of the diagnoses were under the second group (conditions associated with an undiagnosed HIV prevalence of >0,1%).

3,6% of the HIV indicator conditions were AIDS defining among people living with HIV. 4 patients had myocarditis tuberculous diagnosed, 3 patients had bacterial pneumonia and 2 patients had anogenital herpesviral infection diagnosed. Myocarditis

tuberculous is a leading cause of cardiac death among HIV-infected patients, accounting for 6 times higher mortality rates compared with uninfected people [56]. Bacterial pneumonia has a significant impact on the mortality of HIV patients. The study where bacterial pneumonia and the association between HIV infection was compared, found that the rate of bacterial pneumonia among 9885 HIV infected woman was 8.5 cases per 100 person-years, compared with 0.7 cases per 100 person-years in 425 noninfected women [57]. Several studies have shown high association between anogenital herpesviral infection and HIV [58]. None of the above-mentioned diagnosis led to detecting an undiagnosed HIV patient in primary care level.

7,9% of indicator conditions were not included in Estonian HIV testing guidelines. Indicator conditions included mostly symptom-like illnesses for example unspecified fever and weight loss that are typically occurring in the first 2 or 3 weeks after the infection, providing possibilities to detect HIV infected patient as early as possible.

4.1.4 HIV testing

In the pilot study, the author of this research, used a quasi-experimental study design and more precisely, one-group pretest-posttest design. In this research, the author measured HIV testing rates before introducing the intervention and HIV testing rates after the intervention. For a better comparison, the periods had to be in the same time window considering the flu and virus phases in a year. Selected pretest dates were October 2017 till April 2018.

Primary health centres	**Pretest phase (October 2017-April 2018)**	**Posttest phase (October 2018-April 2019)**	**HIV tests carried out due to the reminder**	**HIV tests carried out without reminder**	**Difference in testing rates (%) Pretest vs Posttest**
Jürgenson PAK OÜ	40	131	62	69	328%
Merekivi perearstid OÜ	26	156	122	34	600%

Pirita-Kose perearstikeskus OÜ	38	154	64[1]	90	405%
TOTAL	**104**	**441**	**248**	**193**	**424%**

Table 6. Pretest and Posttest period comparison

As shown in Table 6, during the period of October 2017 – April 2018 104 HIV tests were made by the 3 primary health centres. 248 HIV tests were made taking HIV CDSS's reminder into consideration and 193 HIV tests were done for other reasons at the same time period (October 2018 – April 2019). The testing rates increased fourfold during the intervention period. All the test results were negative.

4.2 Patients' acceptance of participating in the study and making an HIV test

4.2.1 Acceptability of participating in the pilot study and HIV test offer

252 patients (94%) out of 268 accepted to participate in the pilot study. 8 patients' informed consents were not signed, and 8 patients declined the offer to participate in the pilot study. Health care providers reported in an online questionnaire, that it was easy to convince patients to participate in the pilot study and the level of patient satisfaction was high, when the health care provider offered an HIV test.

One general practitioner stated *"It was easy to explain the necessity to participate in the pilot study and actually, patients did not have extra questions about the pilot study. I think they trust us and take our suggestions very seriously."*

On the other hand, the need to explain the ongoing pilot study, get signed informed consent from the patient, turned out the be very time consuming. As one of the residents stated *"It's not a problem nor time consuming, when there's no need to take signed informed consent from the patient. I do not like to make huge fuzz about the HIV test, and I tend to take it as a normal test. It helps to normalise the HIV topic and I usually*

[1] In Pirita-Kose perearstikeskus OÜ 4 patients were included in the pilot study, but they disagreed to make an HIV test.

explain all the tests I'm willing to take for the patients. So, one new analyse to make and explain is not a problem for me."

248 patients (98%) out of 252 accepted to make an HIV test. All the HIV test results were negative. The main reasons for declining the test were a recently done HIV test and not being sexually active.

4.3 GPs' attitude towards provider-initiated HIV testing strategy and indicator condition-guided HIV testing method

The online questionnaire was conducted to get an overview of general practitioners' standpoints about the provider-initiated HIV testing strategy and indicator condition-guided HIV testing method. Furthermore, health care providers' attitudes, barriers and facilitators to use HIV CDSS were explored.

4 general practitioners (40%) out of 10 answered the online questionnaire. In addition to general practitioners, viewpoints from residents and family nurses were explored and included. As they were actively taking part of the pilot study, having their own independent appointments and counselling sessions with patients.

9 health care providers answered the online questionnaire, including 4 general practitioners, 3 family nurses and 2 residents. All the 3 primary health centres were included.

The online questionnaire was mainly divided into 2 chapters:

1) HIV indicator condition-guided testing approach as a clinical method and

2) Primary healthcare providers' barriers and facilitators to use the HIV CDSS

All the other chapters including characteristics and reflections were complementary data.

4.3.1 Online Questionnaire results: HIV indicator condition-guided testing approach as a clinical method

One of the aims of this research is to explore the attitude towards the HIV indicator condition-guided HIV testing approach. The author of this research asked 6 questions under this chapter.

6 health care providers (66,7%) out of 9, reported that they were not aware of the HIV indicator condition-guided testing method before participating in the pilot study. One of the participants commented that she did not know about the method but knew that some of the diseases might be associated with undiagnosed HIV.

5 participants (55,6%) were familiar with the HIV testing medical guideline published in 2012 and thought that the HIV indicator condition-guided testing method is evidence-based. 3 health care professionals answered "Not sure" and provided a justification for the decision that the majority of indicators suggested by the HIV CDSS were connected with females (for example 12,7% of pilot study's indicators were candidiasis of vulva and vagina) and therefore, leaving male patients behind the scenes. Even though, according to their sexual behaviour they might have been suitable candidates.

66,7% of participants agree that the introduced method is suitable and fits well into the daily workflow of Estonian health care provides. 3 participants argued that the method itself is suitable for the primary care, but there is a need to re-visit the indicator condition specification and make clarifications about the timeframes. For example, how long should the algorithms look back in a patient's medical history and search specific indicator conditions and when might be the right time to suggest an HIV test again for the same patient. General practitioners pointed out that the timeframe for candidiasis should be shortened and 2-year-period is too long for that particular disease.

The author of this research asked health care providers' attitude towards the inclusion of indicator condition-guided HIV testing method into the Estonian primary health care quality system as one of the quality indicators. 77,8% of participants agreed that this novel method should be included in the primary health care quality system. 1 participant stated that it is too early to incorporate the new quality indicator into the system, as there has to be a very concrete medical guideline with appropriate guidance (to whom exactly GPs have to suggest HIV tests, what are the timeframes for suggestions, and

what are the areas in Estonia where indicator condition based testing method should be expanded). One of the participants who disagreed with the quality indicator argued that there are already too many quality indicators in the system and adding one more, might be too time-consuming for the whole primary health centres' team to follow.

A separate question about the other methods and facilitators was asked from the health care providers, who thought that the method should be included in the quality system. The answers were following:

a) "There should be more time for working with the patient and less bureaucracy. Possibility for smaller practice list to ensure work quality and patient satisfaction."

b) "Digital reminders should be included in my medical software in a future as well and the "red" flag suggesting HIV tests is totally enough."

c) "I wish that this reminder would be integrated with national health information system. Then I would know when a gynaecologist made an HIV test yesterday and there is no need for me to ask again."

d) "There should be a proper medical guideline, which guides general practitioners and other health care providers to whom we need to suggest HIV tests, testing frequencies and defines concrete HIV testing areas in Estonia."

All the participants (100%) admitted that the digital reminder suggesting to whom they need to make an HIV test will help to enhance the implementation of HIV indicator condition-guided testing strategy in the primary care level in Estonia.

4.4 Primary healthcare providers' barriers and facilitators to use the HIV CDSS

4.4.1 Online Questionnaire results: HIV clinical decision support tool as a technical solution

As all the participants stated that the HIV CDSS is feasible solution and fits into their daily workflows, the question about the barriers was not answered. The question included technical, organisational and personal barriers like “It takes too much time to use”, “Requires too many changes in the current workflow”, “Digital reminders disturb working” or “I don’t trust digital reminders and I’d like to decide myself to whom I suggest HIV testing”.

One of the suggestions for the technical solution was mentioned in a discussion and reflection chapter, where the participant stated that indicator conditions have to be re-validated and some timeframe for the medical history analysis should be incorporated.

On the other hand, the author asked about the ignorance of digital reminders. The main reason for ignoring the digital reminder was when a patient stated that (s)he already has done the HIV test or (s)he is not sexually active.

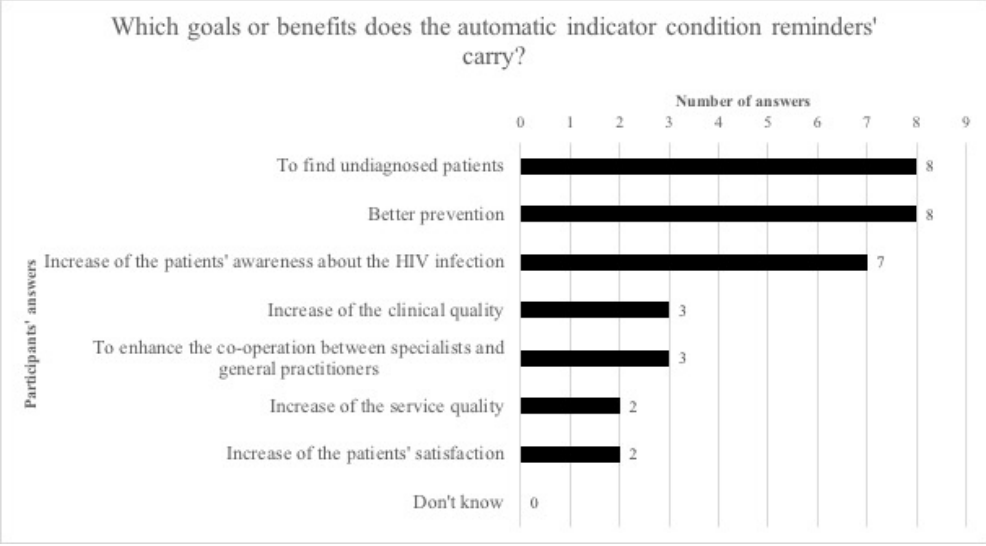

Figure 3. Question “Which goals or benefits does the automatic indicator condition reminders carry?”

As shown in Figure 3 the majority of participants answered that the digital reminders of HIV CDSS will help to find undiagnosed patients (88,9%), enhance the HIV prevention (88,9%) and increase the patients' awareness about the HIV infection (77,8%).

88,9% of the participants answered that they would like to use the HIV CDSS algorithms in the future and one of the health care providers stated that she would like to use is in the future, but the timeframe has to be developed including when is the right time to make a new HIV test for the same patient.

5 Discussion

HIV infection has rapidly spread since the early 1980s and is still causing approximately 1 million deaths every year globally. Estonia has the second highest rate of newly diagnosed HIV cases in the EU/EEA region. Every year approximately 250 individuals from Estonia gets their HIV infection diagnosed. Moreover, around 20 patients are diagnosed in an AIDS stadium referring to late diagnosis. According to the ECDC report published in 2018, 53% of people living in WHO region are detected when their CD4 cell counts have fallen to below 350 per mm^3 and 32% of individuals are detected with advanced HIV infection [3].

Therefore, new prevention methods should be implemented to tackle the ongoing HIV epidemic. Nowadays, the national recommendations are focusing to include and combine several prevention methods into one strategy [27]. One of the cornerstones for prevention methods is to enhance the HIV testing uptake and possibilities to test in different health care settings [32] [30] [7] [8] [9].

Most of the European countries are recommending risk-factor-based HIV testing methods, where doctors offer HIV tests at the patient's request or when a doctor finds that the patient might be in a key population group [33] [44]. Key populations are according to WHO defined as people who inject drugs, sex workers, men who have sex with men, people in prisons and other closed settings and transgender people [33]. In Estonia, medical guidelines and HIV/AIDS strategy documents are focusing on first four key populations [30]. This approach is widely accepted by the health care providers, but according to HIV testing rates done in primary health centres and low participation level confirms the need for alternative and innovative methods to detect the right HIV target groups.

One of the alternative strategies to detect hidden HIV patients is using indicator condition-guided HIV testing approach. This approach has many benefits in terms of cost-efficiency, testing the right target group, detecting hidden HIV patients and being a

feasible method for general practitioners and other health care providers to include it into their daily practice [14].

The author of this research conducted a quasi-experimental pilot study with the aim to evaluate the indicator condition-guided HIV testing strategy feasibility in Estonian primary care level and integrated HIV CDSS algorithms into general practitioners' medical platform to measure its acceptability and usage by the health care providers. In addition to previously mentioned aims, the author conducted an online questionnaire to explore health care providers attitudes towards the provider-initiated HIV testing method and to identify barriers and facilitators to use HIV CDSS on a wider scale.

There are multiple studies providing clear evidence on the improvement of clinical outcomes and HIV testing rates when the indicator condition-guided testing strategy is combined with electronical prompts. The most important outcome – increased level of HIV testing rates – will be discussed in next chapter.

5.1 The prevalence of HIV indicator conditions and HIV testing in primary health centres

Primary health care plays massive role in provider-initiated HIV testing strategy as usually the first contact point in health care for patients. Joore et al. (2015) stated in their article that 58,8% of patients had an indicator condition diagnosed 5 years before getting HIV diagnosis and 61,8% of patients visited their GPs at least once in year [14]. The Estonian National Institute for Health Development argued that 71% out of 538 HIV positive patients had several contacts with their GPs two years before being diagnosed [15]. Therefore, the primary care level was selected for the pilot study.

In this research, 3 primary health care centres were analysed, and 268 patients had an appointment during the pilot study, and had at least one indicator condition diagnosed. 252 patients were eligible for the research and the majority (68%-76%) of the participants were female. The median age was 42. Similar findings and patient demographics are shown in Redondo et al (2019) study [55].

The objective of this research was to compare HIV indicator condition-guided testing strategy with current general practitioners' everyday practice. The quasi-experimental one-group pretest-posttest study design allowed to make this comparison by evaluating

the impact of digital reminders. The chosen method is one of the strengths of this research study providing a possibility to measure concrete clinical outcomes and influences of the digital reminders.

Several studies are showing similar results in terms of the HIV tests provided before the integration of digital reminders and after the intervention. The most effective clinical outcome – increased HIV testing rates – has been identified and analysed. Avery et al (2013) observed four times higher HIV testing rates during the intervention phase [50]. Three-fold higher HIV testing rates were identified by Redondo et al. (2019) [55]. In this research, the HIV testing rates increased four times (104 HIV tests were carried out during October 2017 – April 2018 and 441 HIV tests were done during intervention period October 2018 – April 2019). Research revealed that while the digital reminder system is working combined with indicator conditions and suggesting to make an HIV tests for patients diagnosed with indicator diseases, the overall HIV testing awareness at the primary health centre will increase as well. The results during pretest phase showed that all 3 primary health centres made 104 HIV tests and during the intervention phase 193 HIV tests were carried out without reminders. Routine reminders and confidence to counsel patients on the HIV topic are the positive side-effects disclosed in this research study.

5.2 Patients' acceptance of participating in the study and making an HIV test

Patients' acceptance to participate in the study was perceived as an obstacle by the general practitioners, health providers and author before the pilot study phase. It is now clear that the participation level is very high in this research, reaching up to 94% out of 268 patients. 8 patients' informed consents were not signed, and 8 patients declined to participate in a pilot study. The author of this research conducted an online questionnaire to gain insights about the GPs perception to offer the participation in the pilot study. Unexpectedly, the answers reported were quite opposite. According to findings, it was very easy for GPs to explain the necessity to participate in the pilot study. Same expressions were reported by the other health care providers. On the other hand, it was stated that the provision of HIV tests would have been more comfortable when a written informed consent would not have been mandatory.

The acceptance to make an HIV test has been described as one of the patient-related barriers and is usually related to the fear of legal consequence of positive testing or lack of information about the HIV testing and diagnoses [44]. Despite the patient's fear, doctors can influence the testing uptake by providing evidence-based information about HIV during the counselling. Therefore, the HIV testing uptake shows great numbers in numerous studies. Dominguez-Berjon et al. (2017) reported that 80% of the study population agreed to make an HIV test [45]. Roy et al. (2009) introduced 96% of the acceptability to make a test [8]. In this research, 98% of the patients included in the study accepted to make an HIV test.

5.3 GPs' attitude towards provider-initiated HIV testing strategy and indicator condition-guided HIV testing method

Joore et al. (2017) analysed barriers and facilitators towards the provider-initiated HIV testing strategy [46]. Main barriers were content-related, organisational or patient-related barriers. In Joore et al. (2017) study, GPs worried to offer HIV tests and judge patient's sexual behaviour [46]. On the contrary, Estonian GPs and health care providers did not report any issues related to the above-mentioned barrier. The online questionnaire results exposed that providing an HIV test is not an issue and it should not be a stigmatised topic to discuss.

Deblonde et al. (2018) and Joore et al. (2017) articles reported similar results in the organisational category. Findings about the organisational barriers had the most overlapping topics with the research conducted by the author [48] [46]. Topics included the following barriers: discussing about HIV is time-consuming, GPs felt unsure about the period when an HIV test has to be performed again and requiring concrete guidance to whom HIV tests have to be suggested.

On the facilitators' part, the most mentioned findings in several studies are targeted testing and clinical decision support tools to help to enhance the HIV testing in primary health care [14] [50] [17] [51] [48] [5]. The same results appeared in this research, where 66,7% of the health care providers agreed that the IC-guided testing strategy is suitable method and fits well into the daily workflow of Estonian primary care

providers. Almost 80% of the participants agreed that the IC-guided testing approach should be included in the primary health care quality system as one of the quality indicators.

5.4 Primary healthcare providers' barriers and facilitators to use the HIV CDSS

Kawamoto et al. (2005) described key features for implementing clinical decision support systems into health care providers workflows [59]. The main feature critical to success was that the clinical decision support system had to provide time and location-based suggestions. It was reported that the CDSS should be integrated into already existing medical platforms minimising the need to use separate programs [59]. The current research integrated the HIV CDSS into Perearst2 medical program and all the algorithms were running behind the scenes automatically.

None of the online questionnaire participants saw any barriers in using HIV CDSS. Health care providers made suggestions to re-visit the list of indicator conditions and define the concrete timeframes when it would be feasible to suggest HIV tests again. This suggestion came up in a Joore et al. (2017) article as well, when a GPs suggested to shorten the list of indicator conditions and re-visit their clinical evidence.

88,9% of the participants in an online questionnaire agreed that the HIV CDSS will help to find undiagnosed HIV patients and enhance HIV prevention. 77,8% stated that the HIV CDSS will help to increase patients' awareness about HIV.

All participants agreed that the HIV CDSS is a feasible method and solution to enhance HIV testing in Estonian primary care level and 88,9% answered that they would like to use the technical solution in the future.

5.5 Limitations and future research suggestions

Limitations are the following:

1. All 3 primary health centres were selected based on their management's willingness to use innovative solutions. Therefore, the research did not use randomisation to choose primary health centres.

2. Indicator conditions were based on Perearst2 database and did not include Estonian Health Information System (EHIS) diagnosis.

Future research suggestions are following:

1. Analyse the diagnosis differences between Perearst2 database and EHIS;
2. Compare routine testing method with IC-guided testing method and
3. Analyse the cost-effectiveness to implement IC-guided testing method.

6 Summary

The aim of the research was to evaluate whether an HIV decision support system (HIV CDSS) designed to follow indicator condition-guided HIV testing strategy increases the rate of HIV diagnostic tests done by primary care professionals and how feasible the approach is to integrate HIV CDSS in the primary care level in Estonia.

The author of this research used the quasi-experimental one-group pretest-posttest study design. The research found that the HIV CDSS incorporated with IC-guided testing strategy helps to increase HIV testing rates four times in Estonian primary care level. Furthermore, implementing IC-guided testing approach will help to enhance the overall HIV testing rates as routine reminders are increasing primary health care providers' confidence to discuss the HIV topic with patients. Digital reminders are considered to be as one the most important facilitators to enhance to IC-guided HIV testing strategy.

The first objective of this research paper was to analyse HIV indicator conditions prevalence in the primary care level. During the 6-month period, 268 patients diagnosed with at least one indicator condition had an appointment with their health care provider. 13% of eligible patients had 2 indicator conditions diagnosed and 2% of the study population had at least 3 HIV indicator condition diagnosed. The most frequently identified indicator conditions were candidiasis (25%), candidiasis of vulva and vagina (12,7%), atypical psoriasis (8,7%), unspecified fever (7,1%), herpes zoster (6,7%), unspecified pneumonia (5,6%), seborrhoeic dermatitis (4,8%), zoster without complications (3,6%) and other specified predominantly sexually transmitted diseases (2,8%). 3,6% of the identified diagnosis were categorised as AIDS defining conditions among people living with HIV. 4 patients had myocarditis tuberculous diagnosed, 3 patients had bacterial pneumonia and 2 patients had anogenital herpesviral infection diagnosed.

The second and third objectives were to compare IC-guided testing strategy with the current daily practice and to measure HIV CDSS in primary health care centres in

Estonia. All of the participants admitted that the digital reminder suggesting to whom they need to make an HIV test will enhance the implementation of the HIV indicator condition-guided HIV testing strategy in the primary care level in Estonia. Participants reported that the HIV CDSS is suitable and feasible method in their daily workflows and 88,9% stated that they would like to use HIV CDSS in a future. 77,8% of participants agreed that the novel and innovative method should be included in the primary health care quality system. One of the participants stated that it is too early to include indicator condition-guided testing into the quality system as general practitioners need specific HIV medical guidelines.

Fourth objective was to integrate HIV CDSS algorithms into general practitioners' medical platform to measure its feasibility and the readiness to use it by the GPs. As all the participants answered that the digital reminders incorporated with indicator conditions is feasible technical solution, none of the participants answered to the question about the barriers that the HIV CDSS might have. Health care providers gave suggestions to re-visit the list of indicator conditions and shorten the list integrated into the general practitioners' medical platforms. 88,9% of the participants reported that the HIV CDSS will help to find undiagnosed patients and enhance the HIV prevention. 77,8% answered that the HIV CDSS will increase the patients' awareness about the HIV infection. 88,9% of the participants described that they would like to use the HIV CDSS algorithms in the future.

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Appendix 1 – List of indicator conditions

1. Conditions which are AIDS defining among PLHIV*	2a. Conditions associated with an undiagnosed HIV prevalence of > 0.1	2b. Other conditions considered likely to have an undiagnosed HIV prevalence of >0.1%
Strongly recommend testing:	Strongly recommend testing:	Offer testing:
Neoplasms:	Sexually transmitted infections	Primary lung cancer
Cervical cancer	Malignant lymphoma	Lymphocytic meningitis
Non-Hodgkin lymphoma	Anal cancer/dysplasia	Oral hairy leukoplakia
Kaposi's sarcoma	Cervical dysplasia	Severe or atypical psoriasis
Bacterial infections	Herpes zoster	Guillain–Barré syndrome
Mycobacterium Tuberculosis, pulmonary or extrapulmunary	Hepatitis B or C (acute or chronic)	Mononeuritis
Mycobacterium avium complex (MAC) or Mycobacterium kansasii, disseminated or extrapulmonary	Mononucleosis-like illness	Subcortical dementia
Mycobacterium, other species or unidentified species, disseminated or extrapulmunary	**Unexplained lymphadenopathy**	Multiplesclerosis-like disease
Pneumonia, recurrent (2 or more episodes in 12 months)	**Community-acquired pneumonia**	Peripheral neuropathy
Salmonella septicaemia, recurrent	Unexplained leukocytopenia/thrombocytopenia lasting > 4 weeks	Unexplained weightloss
Viral infections	Seborrheic dermatitis/exanthema	Unexplained oral candidiasis
Cytomegalovirus retinitis	Invasive pneumococcal disease	Unexplained chronic diarrhoea
Cytomegalovirus, other (except liver, spleen, glands)	Unexplained fever	Unexplained chronic renal impairment

Herpes simplex, ulcer(s) > I month/bronchitis/pneumonit is	Candidaemia	Hepatitis A
Progressive multifocal leucoencephalopathy	Visceral leishmaniasis	Candidiasis
Parasitic infections	Pregnancy (implications for the unborn child)	
Cerebral toxoplasmosis		
Cryptosporidiosis diarrhoea, > 1 month		
Isosporiasis, > 1 month		
Atypical disseminated leismaniasis		
Reactivation of American trypanosomiasis (meningoencephalitis or myocarditis)		
Fungal infections		
Pneumocystis carinii pneumonia		
Candidiasis, oesophageal		
Candidiasis, bronchial/ tracheal/ lungs		
Cryptococcosis, extra-pulmonary		
Histoplasmosis, disseminated/ extra pulmonary		
Coccidioidomycosis, disseminated/ extra pulmonary		
Penicilliosis, disseminated		

Appendix 2 – Online questionnaire for the pilot study participants

HIV indikaatorhaiguste pilootuuringu tagasiside

Lugupeetud pilootuuringus osalejad!

Esmalt soovime omalt-poolt tänada Teid väga suure töö eest! Kogusime kolme Tallinna perearstikeskuse peale kokku 267 patsiendi nõusolekulehte ja sama palju patsiente said ka HIV testitud.
Oleme jõudnud pilootuuringuga sinna maale, kus toimub aktiivne andmete analüüs ning loodame saada 2019. aastaga suurema analüüsi valmis. Eesmärgiks ikka, et selgitada välja indikaatorhaigustel põhineva testimise efektiivsus ning lisaks analüüsida just digitaalse meelespea toimimist Teie igapäevatöös.

Kaardistamaks suuremaid barjääre, õnnestumisi ja muud tagasidet, palume Teil täita alljärgnev küsimustik. Küsimustik on anonüümne, kuid andmete analüüsi eesärgil küsime perearstikeskuse nime, et teaksime andmegruppe moodustada.

Küsimustikule vastamine võtab umbes 10 minutit.

Suured tänud veel kord osalemast ja ilusat kevadet!
Grete Kikas ja Kristjan Krass

1. **Perearstikeskus, kus töötan**

2. **Olen oma ametilt**
   Märkige ainult üks ovaal.
   - ◯ Perearst
   - ◯ Pereõde
   - ◯ Resident

3. **Kas olite varasemalt teadlik HIV indikaatorhaiguste põhisest testimise meetodist?**
   Märkige ainult üks ovaal.
   - ◯ Jah
   - ◯ Ei
   - ◯ Muu: _____

4. **Kas olite varasemalt teadlik, et Eestis on 2012. aastal heakskiidetud HIV testimise tegevusjuhis?**
   Märkige ainult üks ovaal.
   - ◯ Jah
   - ◯ Ei
   - ◯ Muu: _____

5. **Kas HIV indikaatorhaigustel põhinev testimine tundub Teie jaoks tõenduspõhine lähenemine?**
   Märkige ainult üks ovaal.

   - ◯ Jah
   - ◯ Ei
   - ◯ Pole kindel
   - ◯ Muu: _____

6. **Kui vastasite eelmisele küsimusele "Ei" või "Pole kindel", siis palun kirjutage põhjendus, mis ajendas Teid sedasi vastama**

   _____

   _____

   _____

   _____

   _____

7. **Kas HIV indikaatorhaigustel põhinev testimise meetod sobib Eesti perearstide või -õdede igapäevatöö praktikasse?**
   Märkige ainult üks ovaal.

   - ◯ Jah
   - ◯ Ei
   - ◯ Võib-olla
   - ◯ Muu: _____

8. **Kui vastasite eelmisele küsimusele "Ei" või "Võib-olla", siis palun selgitage peamisi barjääre, mis takistab antud meetodi rakendamist Eesti esmatasandil?**

   _____

   _____

   _____

   _____

   _____

9. **Palun nimetage, millised meetmed soodustaksid HIV indikaatorhaigustel põhineva meetodi rakendamist?**

   _____

   _____

   _____

   _____

   _____

10. **Kuidas Teile tundub, kas HIV indikaatorhaigustel põhinev testimine võiks olla perearsti kvaliteedisüsteemi üheks jälgitavaks indikaatoriks?**
Märkige ainult üks ovaal.

- ◯ Jah
- ◯ Ei

11. **Kui vastasite eelmisele küsimusele "Ei", siis palun selgitage oma vastust**

_____

_____

_____

_____

_____

12. **Kas tehniline meeldetuletus Perearst2 programmis aitaks HIV indikaatorhaigustel põhinevat testimise meetodit paremini rakendada Eesti esmatasandil?**
Märkige ainult üks ovaal.

- ◯ Jah
- ◯ Ei

13. **Kui vastasite "Jah", siis milliseid eesmärke või kasu aitab Teie hinnangul HIV indikaatorhaiguste automaatne teavitus kõige paremini lahendada?**
Märkige kõik sobivad.

- ☐ Kliinilise kvaliteedi kasv
- ☐ Teenuse kvaliteedi kasv
- ☐ Diagnoosimata inimeste leidmiseks
- ☐ Spetsialist-perearsti koostöö tõhustamiseks
- ☐ Patsiendi rahulolu kasv
- ☐ Patsiendi teadlikkuse kasv HIV infektsioonist
- ☐ Parem ennetustöö
- ☐ Ei oska öelda
- ☐ Muu: _____

14. **Kui vastasite "Ei", siis täpsustage tehnilise algoritmiga kaasnevaid takistusi**
Märkige kõik sobivad.

- [ ] Liiga suur ajakulu
- [ ] Vajab liiga palju organisatoorse töö muutmist
- [ ] Digitaalsed meeldetuletused segavad töö tegemist
- [ ] Ei usalda digitaalseid meeldetuletusi ja sooviksin ise valida, kellele HIV testimist soovitan
- [ ] Ei oska öelda
- [ ] Muu: _____

15. **Kas eirasite digitaalset märguannet töölaual?**
Märkige ainult üks ovaal.

- ◯ Jah
- ◯ Ei

16. **Kui vastasite eelmisele küsimusele "Jah", siis palun kirjeldage peamiseid põhjuseid**

_____

_____

_____

_____

_____

17. **Kas sooviksite, et digitaalne meeldetuletus oleks Teil ka tulevikus töölauale integreeritud?**
Märkige ainult üks ovaal.

- ◯ Jah
- ◯ Ei
- ◯ Muu: _____

18. **Soovi korral kirjeldage oma kogemust pilootuuringus osalemisest (kas ja kui raske oli patsientide nõustamine ; kui keeruline oli neid pilootuuringusse värvata ; milline oli patsientide reaktsioon, kui Te neile HIV testi soovitasite ; kas ja kuidas annaks algoritmi paremaks muuta ; kas ja kuidas annaks organisatoorselt protsesse paremini üles ehitada, et algoritmist oleks maksimaalselt kasu)**

_____

_____

_____

_____

_____