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HIV TESTING IN ESTONIAN HEALTH CARE SYSTEM IN 2018

Master's thesis

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HIV TESTIMINE EESTI TERVISHOIUSÜSTEEMIS 2018. AASTAL

Magistritöö

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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

Background: In Estonia, there has been no significant reduction in the number of new HIV cases in recent years. A total of 10,079 persons have been diagnosed with HIV over the years, including 567 persons with AIDS. HIV testing rates in Estonia have been high compared to other European countries. Yet, it is estimated that approximately 900 people are still unaware of their HIV infection in Estonia, and in the last 10 years in approximately 6% of new HIV cases AIDS has been diagnosed within three months of HIV diagnosis.

Aim: The main aim of the thesis was to evaluate HIV testing in Estonian health care system in 2018. More specifically, to analyze how well the national HIV testing recommendations were implemented, which patients were tested for HIV in 2018 and which were not, and to compare HIV testing practices based on the specialty of the doctor.

Method: The study was designed as an observational retrospective quantitative study of the data from the Estonian Health Insurance Fund's database of treatment invoices. HIV testing was evaluated based on all treatment invoices in 2018 (n = 8.1 million) (including insured and not insured patients).

Result: The study results show that national HIV testing recommendations are followed but not consistently. The largest proportion of HIV tested patients were in Ida-Virumaa region (8.8%) and among 16–49 years old patients (12.6%). According to gender, women were tested more than men (9.1% vs 4.3%), and it was largely related to pregnancy monitoring (30.2% out of all HIV tests and 40.4% of HIV tests among women were related to pregnancy monitoring). According to specialty of the doctor, specialist doctors tested considerably more patients than primary care (8.1% vs 1.0%). Comparing different specialties according to HIV testing in case of HIV indicator conditions, the largest testing rates were in infectious diseases, tuberculosis and gynecology. In general, HIV testing rate in case of indicator conditions was low – 10.8% of such treatment invoices included HIV test (3.2% without pregnancy monitoring invoices). In 2018, 95,267 HIV tests were

performed in health care system and 171 new HIV cases were diagnosed – the positivity rate of tests was 0.2%.

Conclusion: Different specialties test more than primary care, although patients mostly have their first contact with primary care. Thus, testing in primary care should be increased. In Harjumaa and Ida-Virumaa everybody in the age group of 16–49 years is recommended to test but testing in this group is low and should be increased. In case of HIV indicator conditions, testing rates are very low and should be improved as these are the patients with the highest probability of HIV infection.

This thesis is written in English and is 81 pages long, including 6 chapters, 7 figures and 20 tables.

Annotatsioon

HIV testimine Eesti tervishoiusüsteemis 2018. aastal

Taust: Viimastel aastatel pole Eestis uute HIV-juhtude arv oluliselt vähenenud. Aastate jooksul on HIV-nakkus diagnoositud 10 081 inimesel, sealhulgas 567 AIDSi juhtu. Võrreldes teiste Euroopa riikidega on HIV-testimine Eestis kõrge. Siiski ei ole Eestis hinnanguliselt umbes 900 inimest oma HIV-nakkusest teadlikud. Viimase 10 aasta jooksul on umbes 6%-l uutest HIV-juhtudest AIDS diagnoositud kolme kuu jooksul HIVi diagnoosi saamisest.

Töö eesmärk: Magistritöö peamiseks eesmärgiks oli hinnata HIV-testimist Eesti tervishoiusüsteemis 2018. aastal. Täpsemalt uuriti, kui hästi rakendati riiklikke HIV-testimise soovitusi, milliseid patsiente testiti HIVi suhtes 2018. aastal, ja võrreldi neid testimata patsientidega. Samuti võrreldi HIV testimise tavasid arstlike erialade lõikes.

Meetod: Uuringu ülesehitus põhines vaatluslikule tagasiulatuvale kvantitatiivsele uuringule. Andmeid saadi Eesti Haigekassa raviarvete andmebaasist. HIV-testimist hinnati kõigi raviarvete põhjal 2018. aastal (n = 8,1 miljonit) (sisaldasid kindlustatud ning kindlustamata patsiente).

Tulemused: Uurimustulemused näitavad, et riiklikke HIV-testimise soovitusi järgitakse, kuid mitte järjekindlalt. Kõige enam patsiente testiti Ida-Viru maakonnas (8,8%) ning 16–49 aastate vanuserühmas (12,6%). Võrreldes testimist soo põhiselt, siis HIV teste teostati oluliselt rohkem naiste kui meeste seas (9,1% vs 4,3%) ning see on suuresti seotud raseduse jälgimisega (30,2% kõigist HIV-testidest ja 40,4% naistele tehtud HIV testidest oli seotud raseduse jälgimisega). Võrreldes erinevaid erialasid ning esmatasandi tervishoiu HIV-testimist, siis eriarstid testisid rohkem patsiente (8,1% vs 1,0%). Võrreldes HIV-testimist indikaatorhaiguste puhul erinevate erialade lõikes, siis oli kõige enam testituid infektsioonhaiguste, tuberkuloosi ja günekoloogia erialade poolt. Üldiselt oli HIV-testimine indikaatorseisundi korral madal – 10,8% raviarvetest sisaldasid HIV

testi (3,2% ilma raseduse jälgimise raviarveteta). 2018. aastal tehti tervishoius 95 267 HIV-testi ja avastati 171 uut HIV-juhtu – HIV-testide positiivsuse määr oli 0,2%.

Kokkuvõte: Erinevate erialade spetsialistid testivad rohkem, kui esmatasandi tervishoid, kuigi patsientidel on esmane kokkupuude tavaliselt perearstiga. Seetõttu tuleks testimist esmatasandis tõhustada. Harjumaal ning Ida-Virumaal soovitatakse testida kõiki, kes on 16–49 aastased, kuid testimine nende seas li madal ning seda tuleks suurendada. Indikaatorseisundi olemasolul li HIV-testimine väga madal ning seda tuleks tõhustada, sest need on patsiendid, kellel on kõige suurem tõenäosus olla HIVi nakatunud.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 81 leheküljel, 6 peatükki, 7 joonist ja 20 tabelit.

List of abbreviations and terms

AIDS	Acquired immunodeficiency syndrome
ART	Antiretroviral treatment
ARV	Antiretroviral
ECDC	European Centre for Disease Prevention and Control
ED	Emergency department
EEA	European Economic Area
EHIF	Estonian Health Insurance Fund
EU	European Union
HIDES study	HIV Indicator Diseases across Europe study
HIV	Human immunodeficiency virus
IC	Indicator condition
MSM	Men who have sex with men
MTCT	Mother to child transmission
NIHD	National Institute for Health Development
PCR	Polymerase Chain Reaction
PLHIV	People living with HIV
PWID	People who inject drugs
RNA	Ribonucleic acid
TB	Tuberculosis
US	The United States
WHO	World Health Organization

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1. Introduction

1.1 Background

Acquired immunodeficiency syndrome (AIDS) was described in early 1980ies. June 5th, 1981 is the official awareness day of HIV epidemic [1]. On this day, AIDS was clinically reported for the first time, with five cases among men who have sex with men (MSM) in the United States (US). The virus causing AIDS – human immunodeficiency virus (HIV) – was discovered in 1983 [2]. HIV is a retrovirus, which means it is a ribonucleic acid (RNA) virus [3]. Experts believe it was passed to humans in the early 1900s, probably through a hunted chimpanzee bite [4].

1.1.1 Transmission

HIV transmission takes place only through specific activities. HIV is not transmitted by air or water, insects or pets, sharing toilets, food or drinks, sweat, tears or closed-mouth kissing. Only certain body fluids can transmit HIV infection, like blood, pre-seminal fluid, semen, vaginal fluids, and rectal fluids as well as breast milk [5]. The most common way of HIV transmission in the world is through unprotected sex – anal, vaginal or oral. Anal intercourse is most risky to get HIV infection, it has higher risk than vaginal intercourse. Unprotected oral intercourse is significantly less riskier compared to anal or vaginal sex [6].

HIV spreads also among people who use and inject drugs [7]. HIV is transmitted primarily by sharing needles and syringes or preparing drugs with the same equipment with a person who is HIV infected [5]. There are some factors that have been linked to higher risk of HIV transmission like the type of drugs that are used, how often the drugs are injected, and unsafe locations for injecting drugs [6].

HIV can also be transmitted from HIV positive mother to her baby in the course of pregnancy, delivery or breastfeeding (mother to child transmission, MTCT). MTCT rates range from about 15% to 45%, depending if there are any interventions. With efficient

interventions (antiretroviral treatment (ART) for the mother and a short course of antiretroviral (ARV) drugs for the baby), MTCT rate can be decreased to under 5% [8].

1.1.2 Clinical presentation

HIV weakens person's immune system by damaging the cells that fight daily against disease and infection [9]. Right now, there is no cure in the world against HIV, however HIV replication can be controlled with appropriate medicines [10]. In the 1990ies a clinical staging system and immunological classification were developed for HIV related diseases by the World Health Organization (WHO) [11], [12]. This system is used as a tool to help make medical decisions regarding patients with HIV using standardized clinical parameters. This kind of system can be used only on the basis of patient's clinical symptoms [11].

There are four clinical stages of HIV infection. The first stage is called primary HIV infection, which appears 2–4 weeks after contracting HIV. The person might feel sick with flu-like symptoms [9], [12]. Also, some persons may have permanent generalized lymphadenopathy for longer than six months (which doesn't include inguinal lymph nodes). In the second stage, which is called generalized lymphadenopathy, different clinical findings can also appear. For example, dermatological conditions (such as mouth ulcers, herpes zoster, fungal nail infections), unexplained weight loss, and recurrent respiratory infections (for example bronchitis, sinusitis) [11]. The third stage is called generalized lymphadenopathy, which lasts for three months or more [9], [12]. Also, there might be clinical symptoms, like chronic diarrhea, that has lasted longer than one month, unexplained serious weight loss, constant oral candidiasis, oral hairy leukoplakia, acute bacterial infections, inexplicable neutropaenia, anemia or chronic thrombocytopenia [13]. In the last stage, symptomatic phase (also called AIDS), HIV infection is generally manifested with multiple infections and diseases which affect the whole body. Being at this stage, it is very difficult to handle HIV replication and it is difficult to improve patient's health condition [9], [12]. In the last stage, conditions like chronic herpes simplex infection (more than one month), HIV encephalopathy, extrapulmonary tuberculosis, central nervous system toxoplasmosis, HIV associated nephropathy, or cardiomyopathy may manifest [13].

1.1.3 Treatment

After HIV diagnosis, the ART should be started as soon as possible. With ART HIV infection cannot be completely cured, but it can be kept under control and people can live healthier lives. ARV drugs stop the replication of HIV [14]. ART prevents further destruction of immune system. The main goal of ART is to decrease person's viral load to undetectable level. Undetectable viral load means that HIV is low enough not to be detected [9]. ARV drugs can also sometimes cause side effects. Those effects can be controllable, like vertigo and headaches, but there can be some side effects that are quite serious, like liver damage [15].

1.2 Epidemiological situation of HIV

1.2.1 Europe

Since 2008 WHO and the European Centre for Disease Prevention and Control (ECDC) have collectively conducted enhanced surveillance of HIV and AIDS in Europe. Even though HIV infection can be prevented, HIV spreads significantly in the WHO European region (53 countries). In the WHO European Region over the last three decades, 2.3 million people have been diagnosed and reported with HIV, including over 650,000 people in the European Union/European Economic Area (EU/EEA) [16]. In 2017, in the 50 countries of the WHO European Region there were 159,420 newly diagnosed HIV cases, which correlates to an incidence of 20.0 newly diagnosed infections per 100,000 population. In the West of the region there were 22,354, in Centre 6205 and in East 26,459 newly diagnosed HIV infection cases. This correlates respectively to an incidence of 6.9, 3.2, and 23.6 newly diagnosed cases per 100,000 population [16]. In 2018, in the WHO European Region, in 50 countries there were 141,552 newly diagnosed HIV infections (16.2 newly diagnosed infections per 100,000 population) [17]. The trends have been similar in the last decade, with the highest rates and overall numbers of HIV in the East of the Region (44.8 per 100,000 population). In the West the rates and numbers were lower (5.5 per 100,000 population) and in the Centre the numbers were the lowest (3.3 per 100,000 population) [17]. Over the last decade in the WHO European Region the number of people newly diagnosed with HIV has increased by 22% [15]. According to 2017 and 2018 data over half (53%) of the cases were diagnosed at a late stage of infection [16], [17]. In the East the percentage of the late diagnosis was the highest (56%),

compared to the Centre and the West (respectively 55% and 49%) [17]. In the region the rate has increased more among men than in women, by the end of 2018, the rate among men was twice as high as in women [17]. The rate of new diagnoses was also higher among men than women, excluding the people who are under 15 years of age [17]. The main HIV infection transmission mode in the East of Region was injection drug use [16], [17]. In 2018 the highest new HIV diagnosis rates were in Russia (59.0 per 100,000, 85,995 cases) and Ukraine (37.3 per 100,000; 15,749 cases) [17].

In 2017, in EU/EEA there were 25,353 new HIV diagnoses, which correlates to 6.2 cases per 100,000 population [16]. In 2018, there were 26,164 newly diagnosed HIV infections (5.6 newly diagnosed HIV infections per 100,000 population) [17]. The primary HIV transmission route differs by geographical area, explaining the variety in Europe of HIV epidemiology [16], [17]. Over the last decade in the EU/EEA the number of people newly diagnosed with HIV has decreased since 2009 by 17% [17]. The rate of new HIV diagnoses in the EU/EEA has decreased in women and men, however faster among women. Both in 2017 and 2018, HIV infection rate was three times higher among men than in women (9.0 and 2.8 per 100,000 population in 2017, and 7.9 and 2.4 per 100,000 population in 2018) [16], [17]. In EU/EEA the proportion of late diagnoses was 49% [17]. Countries with the highest rates of new HIV diagnoses in 2018 were Latvia (16.9, 326 cases), Malta (15.3, 73 cases), and Estonia (14.4, 190 cases). The lowest rates were reported in Slovakia (1.9, 101 cases), and Slovenia (1.7, 35 cases) [17]. The most common route of HIV transmission in EU/EEA is still sex between men. The second most common transmission route is heterosexual contact. In the year of 2017 and 2018, transmission due to injection drug use was the lowest compared to others [16], [17].

1.2.2 Estonia

In Estonia, there has been no significant reduction in the number of new HIV cases in recent years (Figure 1). In 2018, 190 persons were newly diagnosed with HIV infection (14.4 per 100,000 population). In comparison, in 2019, 178 persons were newly diagnosed with HIV in Estonia (13.4 per 100,000 population). A total of 10,079 persons have been diagnosed with HIV over the years and 567 persons with AIDS [18]. The highest rate of new HIV cases in 2019 was in a county called Harjumaa (including capital city Tallinn) (106 cases; 10.3 cases per 100,000 population) and in a county called Ida-Virumaa (including Narva on Russian Federation border, the third largest city in Estonia) (44 cases; 32.3 per 100,000 population). As in previous years, in 2019 the rate of new diagnoses was higher among men than in women – among men 113 cases (18.1 per 100, 000 population) and among women 65 cases (9.3 per 100,000 population). Both genders had the highest number of HIV infections in the age group of 30–44, among men 70 cases (47.7 per 100,000 population) and among women 31 cases (22.7 per 100,000 population) [18]. Based on 2019 data, in 34% of cases, the transmission route was unknown. In 45% of cases, it was heterosexual contact, in 11% of cases injection drug use, in 9% of cases homosexual contact, and in 1% other parenteral route (unpublished data as of May 8th, 2020).

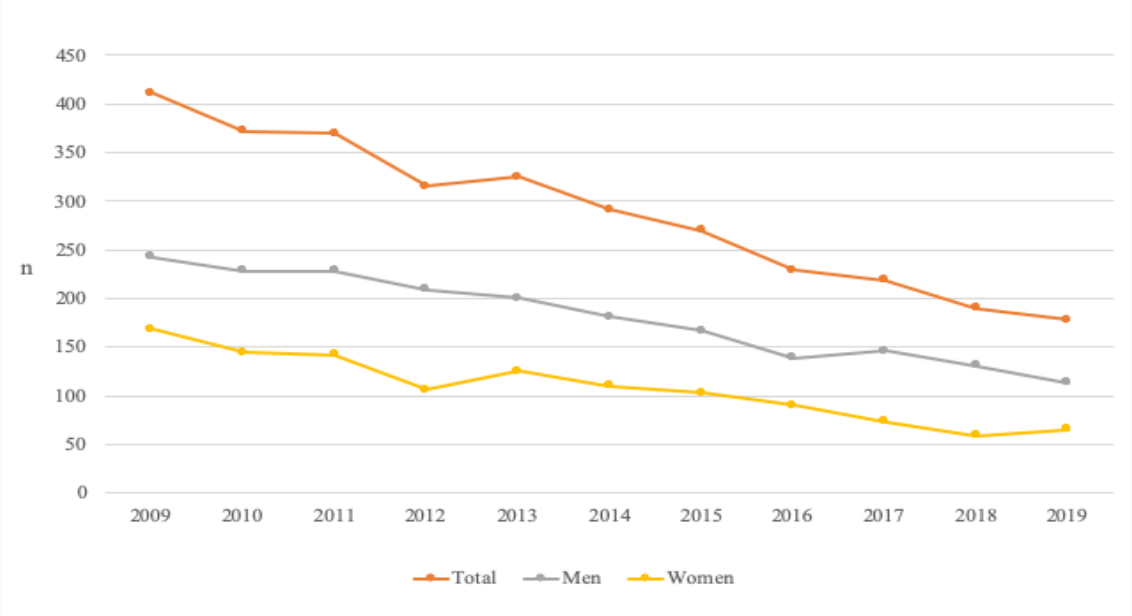

Figure 1. The number of new HIV cases in Estonia in 2009–2019. Source: Health Board [18]

1.3 HIV diagnosis

HIV is diagnosed by detecting HIV antibodies or components of virus (proteins or nucleic acids) in body fluids of the infected person. This is called HIV testing [19]. The nature of testing and the possibility of a "window period" must be explained to the patient before the test. The "window period" is the time between the time of infection to the time when the test becomes positive, that is, shows infection with HIV [19]. The length of the "window period" depends on how HIV is detected (what type of HIV test is done) [20]. Most of the time, venous blood or finger prick blood is used. Sometimes saliva is used, too [21].

There are different kind of HIV testing possibilities:

1. HIV antibody tests, where the test identifies specific antibodies against HIV. If this kind of specific antibodies are detected, it means that the body responds to HIV infection. It takes at least three months for the human body to produce sufficiently high quantities of HIV antibodies for these kinds of tests to be accurate [21].
2. HIV antigen tests detect proteins that are part of HIV itself, so-called p24 protein. The level of p24 in the body of the person infected is high enough 2–4 weeks after initial infection for the combined antigen/antibody test to accurately detect HIV [21].
3. Polymerase chain reaction (PCR) tests detect HIV RNA [22], [23]. Thus, the infection can be detected very early, before antibodies develop [22]. PCR "window period" time is the shortest, three days to four weeks after an exposure to HIV [22], [23].

HIV testing can also be classified as follows:

1. Laboratory testing of the patients' blood, where mostly immunoblot (EIA, ELISA, Western Blot) and polymerase chain reaction (PCR) are used [19]. These test systems have the shortest window period, which is usually 3–4 weeks, and they are most specific and sensitive [20].
2. Point of care HIV testing or rapid HIV testing, which is performed right where the patient is. Usually, anti-HIV antibodies are detected with the rapid test. This approach gives the results in a few minutes (up to 20 minutes). Usually, finger-prick blood or saliva is used and the window period is 10–12 weeks [20], [21].

Rapid HIV test results must usually be confirmed in the laboratory before deciding the final diagnoses [24].

3. HIV self-testing is also possible and the person can do it on their own (and in their home). These are also blood or saliva based rapid tests, with test results within 15–20 minutes. In case the result of the self-testing kit is positive, then it has to be confirmed by laboratory testing. Regrettably, not all countries accept this kind of self-testing at home [21]. In Estonia, there is also an opportunity to do rapid HIV self-testing. People can buy a self-testing kit from the pharmacy and do it at home [25].

1.4 HIV testing recommendations

1.4.1. In the world

In the WHO European region, there are about 2.3 million people living with HIV (PLHIV) and studies show that one in three are unaware of their HIV status [26]. For example, the studies show that in the EU/EEA the estimated proportion of undiagnosed people is around 15% [27]. For public health, HIV status awareness is vital, because it reduces risk behavior [28]. Late HIV infection diagnosis also leads to worse reaction to ART treatment, increased HIV related mortality and morbidity, increased healthcare expenditure [29]. Thus, it is important to test and diagnose people as soon as possible, as it grants people access to treatment, which noticeably decreases associated morbidity and mortality. Detailed testing principles and guidelines will benefit all countries. Some countries in the EU/EEA don't have clear testing policies as shown by recent studies. And if testing policies do exist, they might not be accepted as best practice. This consists the need to pay attention on people with the highest risk of infection, the improvement of testing in an expanded range of settings, acceptance for lay providers to do testing and the use of self-testing [30].

Reaching and testing those at risk of infection HIV is still considered a public health challenge across Europe. Increasing testing coverage and uptake, especially for those most at-risk, is an essential element of any strategy to eliminate HIV in the EU/EEA. ECDC recommends testing to be accessible, voluntary, confidential and contingent on informed consent. Testing in healthcare settings should be normalized [30].

ECDC and WHO recommend that MSM, transgender people, sex workers, people who inject drugs (PWID), people in prison and other closed settings, migrants from high prevalence countries, pregnant women, homeless people, haemodialysis patients, organs or surgical interventions before adequate safety and quality regulations were enforced, people who received blood products, and sexual or injecting partners of people diagnosed with HIV should be tested for HIV. In addition, the implementation of indicator condition (IC) guided HIV testing is recommended in addition to targeted HIV testing of groups at higher risk [24], [30].

A range of European clinical specialty societies have developed guidance, including the ECDC and WHO Regional Office for Europe, that recommend IC based testing. The guidance is partly based on methodology that have developed through HIDES study (HIV Indicator Diseases across Europe study) [26]. The HIDES study is about ICs and it provided proof, that IC based HIV testing can be reasonable, achievable and efficient strategy [29]. The HIDES study affirms that more than 0.1% of people with ICs have HIV infection. The HIDES study also confirms the realizability of such a testing strategy across Europe [29]. Another study on IC based testing in United Kingdom has been proven to be efficient. Instead of asking patient about risk behavior, the clinicians can focus to clinical syndrome. Many ICs are related with HIV prevalence greater than 0.1%, and the cost effectiveness of such testing has now been confirmed [28].

There are three groups of HIV ICs.

1. Conditions or diseases, which are AIDS defining among PLHIV. HIV in Europe guidance strongly recommends HIV testing to any person (who are not known to be HIV positive), who is presenting with a possible AIDS case [26].
2. Conditions, that are not AIDS defining, but are related with an undiagnosed HIV infection, where prevalence of HIV is more than 0.1%. More often this kind of conditions appear in PLHIV. These may occur because of the transmission takes place in the same way (e.g. viral hepatitis) or because the characteristic immune deficiency associated with HIV infection occurs as a result (e.g. herpes zoster) [28].
3. Conditions where not identifying the presence of HIV infection may have significant adverse implications for the individual's clinical management (for

example conditions requiring aggressive immuno-suppressive therapy, idiopathic/thrombotic thrombocytopenic purpura) [26].

1.4.2 Estonia

In Estonia, the latest recommendations on HIV testing was issued by the Ministry of Social Affairs in 2012 [31]. The purpose of the guidance is to ensure early detection of HIV infection, thereby reducing the proportion of people who are unaware of the infection, enabling treatment to be started in right time and helping to prevent further spread of the infection. This guidance describes the patient groups, who have to be tested for HIV infection. Besides, that guidelines are provided for frequency of testing, for pre-test briefing, post-test counseling, contact tracing, and further investigation and treatment of infected patients [19].

The recommendations stresses the importance of confidentiality and protection of sensitive personal information in HIV testing. It is recommended to conduct HIV testing and counseling privately and in a supportive atmosphere. The patient should be made aware that HIV testing is voluntary and the right to refuse testing. Patient's written consent is not required for HIV testing, oral consent is sufficient [19].

In summary, HIV testing (both outpatient and inpatient care) should be offered for the following patients: all pregnant women, newborns of woman with HIV, women, who decide to terminate their pregnancy, suspicion of a sexually transmitted infections (STI) or tuberculosis (TB), people in prison, patients in addiction treatment and rehabilitation programs, people who received blood products, donors of cells, tissues, and organs. Besides that HIV testing is also recommended to the patients with ICs. In Harjumaa, including Tallinn, and Ida-Virumaa, all in- and out-patients aged 16–49 years are recommended to be tested for HIV. Older and younger patients are recommended to be tested according to risks and ICs. The exceptions are the emergency departments (ED), where the testing should be provided according to clinical indications [19].

1.5 HIV testing practices

1.5.1 HIV testing in Europe

The benefits of HIV testing are widely approved, nevertheless there are still gaps to decrease the number of people, who are not aware of their HIV infection. The studies show that in the EU/EEA the estimated proportion of undiagnosed people is around 15%. HIV testing needs to be improved in EU countries, because of the proportion of undiagnosed PLHIV [27]. In 2018, in EU/EEA, the countries with most of HIV tests performed per 1,000 populations were France 86.6, Estonia 85.3 and Belgium 64.0 (testing of blood donations and anonymous testing excluded). Compared to non EU/EEA countries, the most tests were performed in Russia, Kazakhstan, and Belarus (277.8, 150.7, and 136.3 per 1,000 population, respectively) [17]. Among 31 EU/EEA countries, only 12 countries collect these data. Among 25 non EU/EEA countries, 15 countries collect these data consistently [17].

When comparing Estonia's HIV testing level with other EU countries, then the level of testing in Estonia is high. In 2018, 131 persons per 1000 persons were tested for HIV (including all testing) [17]. Excluding unlinked anonymous testing and testing of blood donations, 85.3 people were tested per 1000 population [17]. For example, in Estonia's neighboring countries, Latvia and Lithuania, the number of tests performed per 1,000 population (excluding unlinked anonymous testing and testing of blood donations) were 46.7 and 39.1, respectively, which is significantly less than what was done in Estonia [17].

1.5.2 HIV testing in Estonia

In 1987 Estonia started with biological surveillance of HIV infection, which currently is performed in 33 laboratories (in health care institutions) all across Estonia and in national HIV reference laboratory in Tallinn (West-Tallinn Central Hospital) [31], [32].

In Estonia, any doctor can suggest HIV testing based on patient's wish, risk assessment, or clinical indications [31]. HIV testing is provided only by health care institutions, including prison health services and family medicine centers [31]. Only medical personnel (nurses, midwives, laboratory specialists or doctors) can perform the blood

drawing and rapid testing, non-medical personnel are not permitted to perform HIV testing [19], [31], [32].

There are also HIV counselling and testing sites, where testing is anonymous [32]. In these sites anyone aged 16 or older can take an anonymous and free HIV, hepatitis B, and C testing and counselling, which costs are covered by National Institute for Health Development (NIHD) from the state financing plan [31].

HIV test is automated or semiautomated venous blood test ("window period" 3–4 weeks) and rapid vein or finger-prick blood test ("window period" 8–12 weeks). Only a positive result confirmed by the reference laboratory may be reported to the patient [19]. Rapid HIV tests are usually done in youth counselling centers and anonymous HIV counselling and testing sites [31]. In the case of rapid testing, a positive result is reported immediately, explaining its significance, the possibility of false positives, and the need for confirmatory diagnosis. Venous blood should be taken from the patient and sent to a reference laboratory for confirmatory diagnosis [19].

Rapid testing is mostly used in community settings (drop in centers for sex workers and in needle and syringe exchange programs) in collaboration with local health care organizations. Since December 2016 home HIV tests can be purchased from the pharmacies [31]. Also, since 2016, HIV testing in health care system is free of charge also for people without national health insurance [31], [33]. All HIV test costs are covered either from Estonian Health Insurance Fund (EHIF) (for insured people) or from the state budget (for non-insured people). Since 2017, family doctors have limitless budget for HIV testing according to the national recommendations. This is covered by EHIF [31].

In 1990, over 250,000 people were tested for HIV infection. In the following years, HIV testing dropped significantly, reaching its lowest level in 1999, when 78,000 people were tested, but since 2000, testing has gradually increased again. The level of HIV testing has increased year by year, from which can be inferred, that the decline in new cases is not related to reduced testing. At the same time, the percentage of positive tests (the proportion of new HIV cases among those tested) has decreased, falling to 0.1% of all those tested in 2018 and 0.2% of those without pregnancy and blood donors [34].

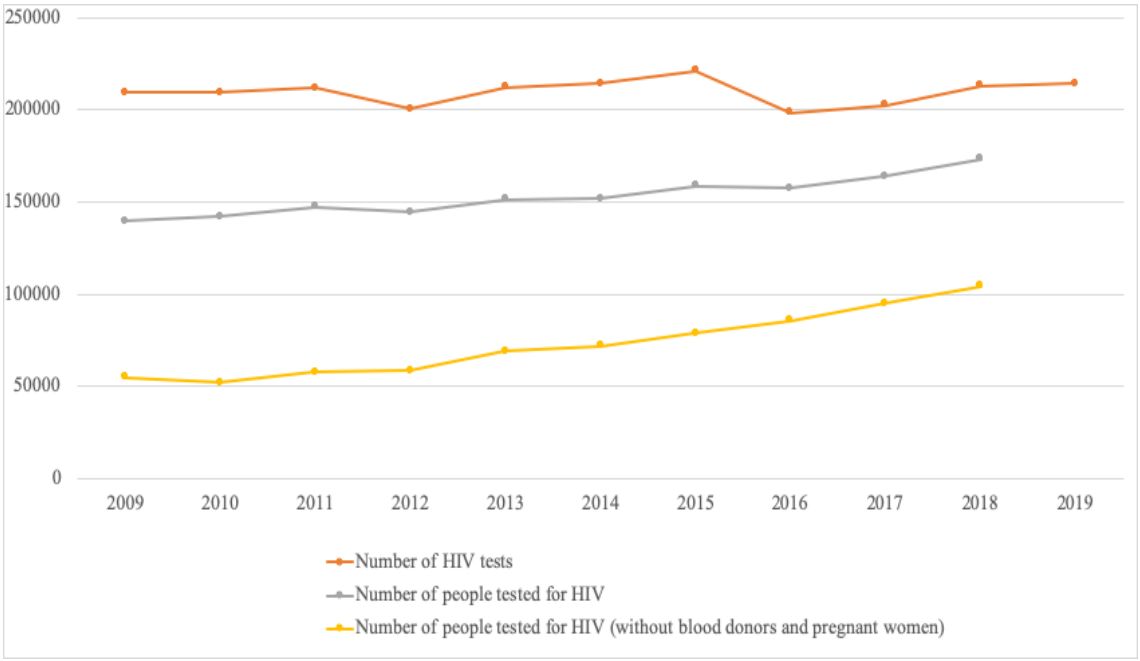

Figure 2. Number of HIV tests and tested people in Estonia, 2009–2019. Source: Health Board [18].

In the recent years, more than 200,000 HIV tests are performed in Estonia annually, about half of them for pregnant women and blood donors (Figure 2) [34] and around 5–6% in the anonymous HIV counselling and testing sites [32].

Despite large numbers of tests and tested people in Estonia, studies have shown that people visit health care facilities many times before being diagnosed with HIV. In 2014–2015, 538 adult HIV cases were reported to Health Board. Of them, 82% had visited healthcare services at least once during the two years before HIV diagnosis; the mean number of visits was 9.1. Of them, 16% had been tested for HIV at least once. One third (31%) had at least one HIV IC on at least one of their treatment invoices. Only 5% of 390 cases of HIV ICs were tested for HIV. Of all new HIV cases aged 20–49 years from high-incidence regions (defined as priority groups in national testing recommendations) in 2014–2015, 18% had been tested at least once in the two years prior to HIV diagnosis. Thus, HIV testing rate in the two years before HIV diagnosis was very low, even in the presence of HIV IC [27].

In 2012–2015 IC-guided HIV testing was assessed in Estonia among people 15–49 years, using data from EHIF. Among the ICs analysed, the highest proportion of patients tested was among those presenting with infectious mononucleosis-like illness (27–33% of patients were HIV tested) and viral hepatitis (28–32%), the lowest proportion of patients

tested was among those presenting with herpes zoster (4–5%) and pneumonia (4–8%) [35].

HIV testing rates were low also among 15–49 years old people visiting healthcare in Tallinn/Harjumaa and Ida-Virumaa – less than one tenth (4–7%) of men and less than one fifth (12–18%) of women were tested [36].

In 2016–2018 the number of HIV tests has increased by patient's gender, age group, place of residence and basic medical specialty. The increase in testing among men has been higher than among women. There were significantly more HIV tests among women than men, while the proportion of women in the new HIV cases is lower than men. In case of age groups, the increase has been more significant among people older than 30 years [30].

The number of tests performed by family doctors has increased three times in 2016–2018. This may be due to the unlimited funding since 01.01.2017. However, the absolute number of family doctors' tests remains very low (in 2017 7336 tests and in 2018 10,235 tests). The number of HIV tests per one family doctor list in 2018 was 13 (range 1–250) [37].

2. Aim of the study

The main aim of the study is to evaluate HIV testing in Estonian health care system in 2018. More specifically:

- To analyze which patients were tested for HIV in 2018 (according to gender, age, region, main diagnoses) and compare them to those who were not tested,
- Compare HIV testing practices based on the specialty of the doctor (family doctors vs specialists),
- To analyze how well the national HIV testing recommendations were implemented,
- Identify the main gaps in testing and provide recommendations for improving testing as well as for future studies.

3. Materials and methods

The study was designed as an observational retrospective quantitative study of the data from the Estonian Health Insurance Fund's database of treatment invoices. HIV testing was evaluated based on all treatment invoices in 2018 (including insured and not insured patients). Only treatment invoices of foreign patients (who don't live in Estonia) were left out (n = 6900). Data were available based on the contract between EHIF and NIHD. As a secondary data analysis based on anonymous data, it did not require permission from ethical review board.

The following data were extracted for all invoices:

- Patient gender (male/female),
- Patient age,
- Place of residence (on county level),
- Name of the health care organization (used for family doctors' data),
- Specialty of the doctor issuing the invoice,
- Main diagnoses (according to ICD-10),
- HIV test (EHIF code in the list of health care services 66719; yes/no) (https://www.riigiteataja.ee/akt/122122015054).

Patient's age was grouped as follows (based on Estonian HIV testing recommendations (33)):

- 0–15 years,
- 16–49 years (or 15–49 years in order to compare with data from 2012–2015),
- ≥ 50 years.

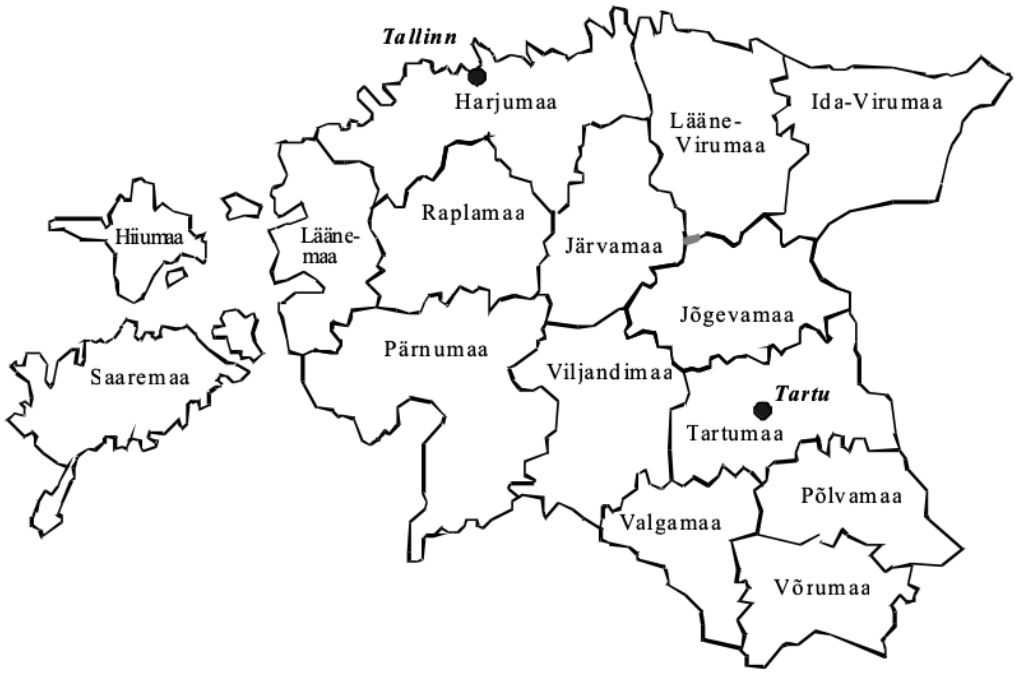

Figure 3. The map of Estonia by counties. Source: the internet [38].

Patient's place of residence was grouped as follows:

1. Harjumaa (high HIV incidence region),
2. Ida-Virumaa (high HIV incidence region),
3. Tartumaa (the second largest county),
4. Rest of Estonia (all other counties),
5. Other (foreign, place of residence unknown).

Diagnoses in treatment invoices were categorized as HIV indicator condition on the basis of ICD-10 (http://rhk.sm.ee/) as follows (based on Copenhagen HIV program recommendations [26]):

1. Tumors C21, C34, C46, C53, C83–C89, D15–D16, N87.
2. Infectious diseases
    - Certain infectious diseases: A02.1, A15–A19, A31, A81.2, A87.2–A87.9, B02, B15–B19, B25.9, B27, B55.0,
    - Certain parasitic diseases: A07.2, A07.3, B57.2, B57.4, B58,
    - Fungal diseases: B37, B39.0–B39.4, B45, B38.3–B38.9, B48.8,
    - Pneumonia: J13, J15–J16, J18.
3. Sexually transmitted infections: A51–A64.

4. Other:
    - Diseases of the blood and hematopoietic organs: D72.8,
    - Nervous system disorders: G35, G56, G57, G59, G61.0, G90.0,
    - Skin and subcutaneous tissue disorders: L21, L40,
    - Diseases of the genital tract: N15.9,
    - Symptoms: R50 (fever of unknown origin), R59.1 (enlargement of the lymph nodes), R63.4 (abnormal weight loss),
    - Mental and behavioral disorders due to opioid use (F11),
    - Pregnancy-related treatment invoices (O, N96, Z32–Z36).

The medical specialties of the treatment invoices were grouped as follows:

1. Surgery (neurosurgery, pediatric surgery, facial surgery, thoracic surgery, cardiac surgery, vascular surgery, general surgery, urology, orthopedics, anesthesiology),
2. Pulmonology,
3. Tuberculosis,
4. Family medicine (primary care),
5. Gynecology and obstetrics (midwives)
6. Oncology,
7. Dermatovenerology,
8. Pediatrics,
9. Psychiatry,
10. Infectious diseases,
11. Otorhinolaryngology,
12. Internal diseases (cardiology, hematology, endocrinology, gastroenterology, nephrology, rheumatology),
13. Other (occupational diseases, rehabilitation, ophthalmology, laboratory medicine, radiology, physiotherapy, dentistry, medical genetics, psychology).

The primary information on specialty did not include emergency department as a separate specialty. These data were a separate category on the treatment invoices which were not available in disaggregated level for the purposes of this study. Also, the data were not available for the type of health care visit (outpatient vs inpatient; face-to-face visit vs telephone/e-mail visit). Only in the case of family doctors, it can be said that there were

no in-patient visits. Data on patient insurance status were also available only on aggregated level.

Populations statistics were taken from Statistics Estonia (www.stat.ee) and data on the number of family doctors' patients lists from Health Board register (http://mveeb.sm.ee/Nimistud/). Aggregated data on newly diagnosed HIV cases based on age, gender and region (previously unpublished) were received from Health Board.

3.1 Data sources and collection

The data sources and collection were from EHIF, population statistics from Statistics Estonia, HIV statistics from Health Board, and the number of family doctors' patients lists from Health Board register.

3.2 Data cleaning and analysis

Data were cleaned and analysed using programs MS Excel and STATA 14.0. Descriptive statistics (absolute numbers, percentages) were used to characterize patients receiving healthcare services and testing during healthcare visit.

4. Results

4.1.1 All treatment invoices

In 2018, there were a total of 8,086,507 treatment invoices. The number of treatment invoices containing HIV test was 95,682, which accounted 1.2% of all invoices (Table 1). Out of all HIV tests, 1.2% (n = 1101) were performed to people with no national health insurance.

Comparing treatment invoices of different specialties in 2018, then more than half of the treatment invoices were from primary care, n = 4,265,237 (52.7% of all treatment invoices). Of all primary care treatment invoices, 0.2% (n = 10,235) contained HIV test. The largest proportion of invoices with HIV test was from the infectious disease specialty (11.4%; n = 4624). The largest number of invoices with HIV tests was from gynecologists (n = 48,579; 9.6%) (Table 1).

Out of all invoices, 3.9% (n = 311,521) included some HIV IC (Table 2). Of the invoices with no ICs, 0.8% (n = 61,892) included HIV test. HIV testing was more common in case of HIV ICs. Out of all invoices with ICs, 10.8% (n = 33,791) included HIV test (Table 2).

The largest category of treatment invoices with ICs included invoices related to the follow-up of pregnancy (n = 157,461; 1.9% out of all invoices, and 50.5% out of invoices with ICs). Of them, 18.3% included HIV test (n = 28,875). Almost the same number of treatment invoices were in infectious diseases and neurology categories of ICs (approx. 33,000). Out of them 5.2% and 0.8%, respectively, included HIV test (n = 1684 and n = 273, respectively) (Table 2).In Figure 4 the proportion of indicator condition related invoices with HIV test according to IC is presented. The biggest proportion of tests were done for pregnancy monitoring (18.3%). Besides pregnancy, the proportion of STI related invoices with HIV tests was also high (9.8%). Invoices with opiates dependency and neurology ICs were tested the least (0.9% and 0.8%, respectively).

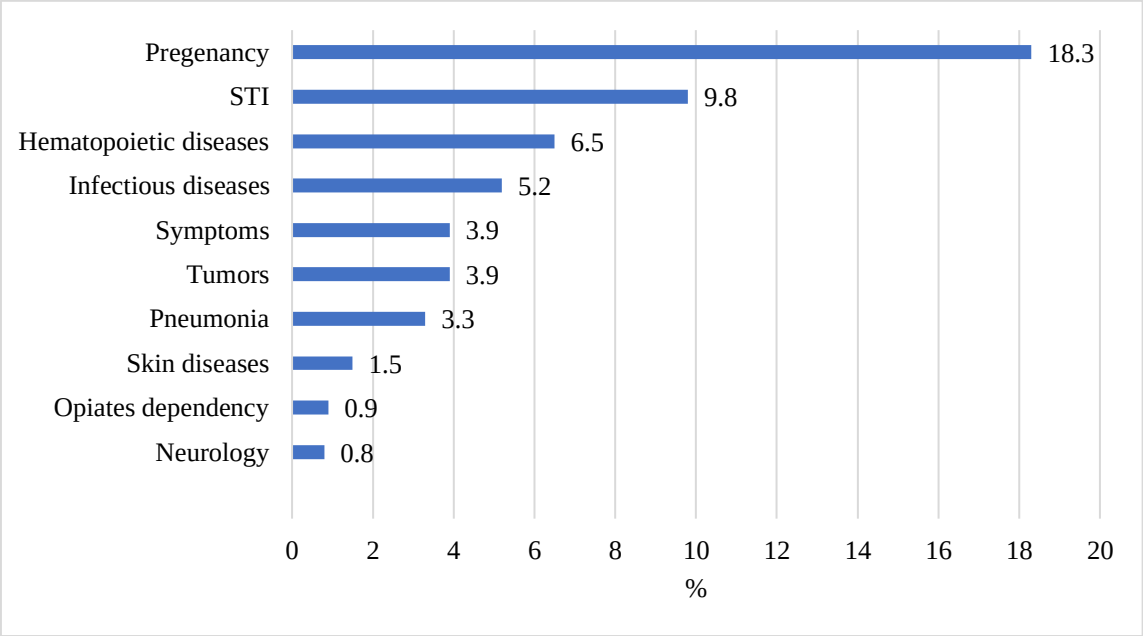

Figure 4. Proportion of indicator condition related invoices with HIV test according to IC, Estonia, 2018 (%).

As HIV testing in pregnancy monitoring is at a high level and many pregnant women are tested twice during pregnancy [34], in tables 3 and 4 invoices related to pregnancy monitoring have been left out. In this case 3.2% of treatment invoices with ICs included HIV test (Table 3).

In case of ICs, HIV tests were performed more among men (3.5%) than women (3.0%). Without ICs, HIV tests were performed more among women (0.9%) compared to men (0.7%). Regarding age groups, HIV testing both with and without ICs was the highest among 16–49 years old (respectively 4.7% and 1.7%) (Table 3). Looking at regions, the most tested with ICs were foreign people or people with unknown residence, which is 18.9% (n = 10). Comparing counties, the largest proportion of people was tested in Ida-Virumaa (4.0%; n = 703) (Table 3).

Comparing IC based HIV testing by specialty, infectious diseases doctors tested the most (17.9%; n = 975) (Table 4). Thereafter, more HIV tests were performed by TB specialists (14.2%; n = 141). Among primary care there were 54,603 treatment invoices with ICs, of which HIV tests were performed in 0.9% cases (n = 464) (Table 4).

There were all together 7,774,986 treatment invoices without ICs, of which 0.8% (n = 61,892) were with HIV test (Table 2). The largest number of such invoices were from primary care, of which were HIV tested 0.2% (n = 9360). The largest proportion of

HIV tests was from infectious diseases specialty (10.4%; n = 3647). Most HIV tests were performed by gynecology specialty – 5.6% (n = 18,906) (Table 4).

Out of all invoices, 5.6% were from ED (n = 456,616), 2.2% of them included HIV test (n = 10,167). Therefore, 10.6% of all HIV tests were done in ED.

4.1.2 Primary care treatment invoices

In 2018, primary care had 4,265,237 invoices, of which 0.2% included HIV test (n = 10,235) (Table 1 and 5). Mean number of HIV tests per one family doctor's list in 2018 was 13 (range 1–250). The three primary care practices with the largest number of HIV tests per one list were: Terve Laps OÜ, Kõue Perearstikeskus, and Perearst Riina Tomson OÜ (all located in Harjumaa).

In case of HIV ICs, the largest proportion of invoices with HIV tests were pregnancy monitoring invoices – 10.0% (n = 411). Secondly, the most tested were hematopoietic diseases (2.9%), but the absolute number of all invoices was very small (n = 105). The percentage of invoices which included HIV test was almost the same for STIs and symptoms (2.6% and 2.7%, respectively) (Table 5).

In case of HIV ICs, slightly more tests were performed among men than women (1.0% and 0.7%; respectively), however, the number of treatment invoices was significantly higher among women than men (Table 6). In case of age groups, the biggest proportion of tests in case of ICs were performed among 16–49 year olds (1.4%). Comparing regions, the largest proportion of invoices with ICs that included HIV test was from Harjumaa and Ida-Virumaa, (1.2% and 1.3%, respectively) (Table 6).

When comparing primary care invoices without HIV ICs, the tests were performed almost equally for men and women (0.3% and 0.2%, respectively). In case of age groups, the largest proportion of invoices with HIV test was among 16–49 year olds (0.6%). Regionally, the percentage of invoices with HIV tests in Harjumaa and in Ida-Virumaa was equal – 0.3% (Table 6).

4.1.3 Specialist doctors' treatment invoices

In 2018, there were 3,667,901 specialist doctors' treatment invoices (except pregnancy monitoring), of which 1.6% included HIV test (Table 7). The invoices which included

HIV ICs almost equally included HIV test for both men and women (4.9% and 4.2%, respectively). Comparing age groups, then HIV tests in case of ICs were done the most in the age group of 16–49 – 6.3% (n = 2874). Comparing regions, the largest proportion of invoices with ICs tested for HIV was in Ida-Virumaa and Tartumaa, 5.2% and 5.0% respectively (Table 7).

All together there were 3,568,444 treatment invoices without ICs. Among women the proportion of HIV tested was a little bit bigger – 1.6% (1.3% among men). In case of age groups, the largest proportion of tested was among 16–49-years old (2.3%). In case of regions, the largest proportion of tested was in Ida-Virumaa (2.0%) (Table 7).

Infectious disease specialty had the largest proportion of HIV tested invoices with ICs – 11.4% (Table 8). In more detail, 31.8% of their invoices with symptoms and 24.3% of invoices with STIs included HIV test. The proportion of treatment invoices with ICs that had HIV test was almost equal among gynecologists and surgical specialties (9.6% and 9.0%, respectively). By gynecologists, the largest proportion of invoices with HIV tests were related to opiate dependency (50.0%). In surgery, the largest proportion of invoices with tests were from patients with tumor diagnosis (9.8%) (Table 8).

4.1.4 All people who received health care services

In 2018, a total of 1,148,227 people received health care services (Table 9). The average number of treatment invoices per person was 7.0. Out of all people, 6.9% were tested for HIV at least once in 2018 (n = 79,795). The proportion of tested was more than two times higher among women than men (9.1% and 4.3%, respectively). In case of age groups, the largest proportion of people tested was among 16–49 year olds – 12.6% (n = 57,003). Regionally, the largest proportion of HIV tested people was in Ida-Virumaa (8.8%; n = 10,572). In Harjumaa and Tartumaa, HIV testing rates were almost equal – 7.9% and 7.0% of people who received health care were tested (Table 9).

In case of age groups, the proportion of tested among both men and women was the largest among 16–49 year olds (6.2% and 18.2%, respectively). Comparing regions, the largest proportion of both tested men and women was in Ida-Virumaa (6.3% and 10.8%, respectively) (Table 10).

The following Figure 5 demonstrates the percentage of people receiving health care services who were tested for HIV at least once according to age and gender. The population group tested the most was 16–49-year old women – 18.2%. Men and women older than 50 years were tested almost equally (4.5% and 4.7%, respectively).

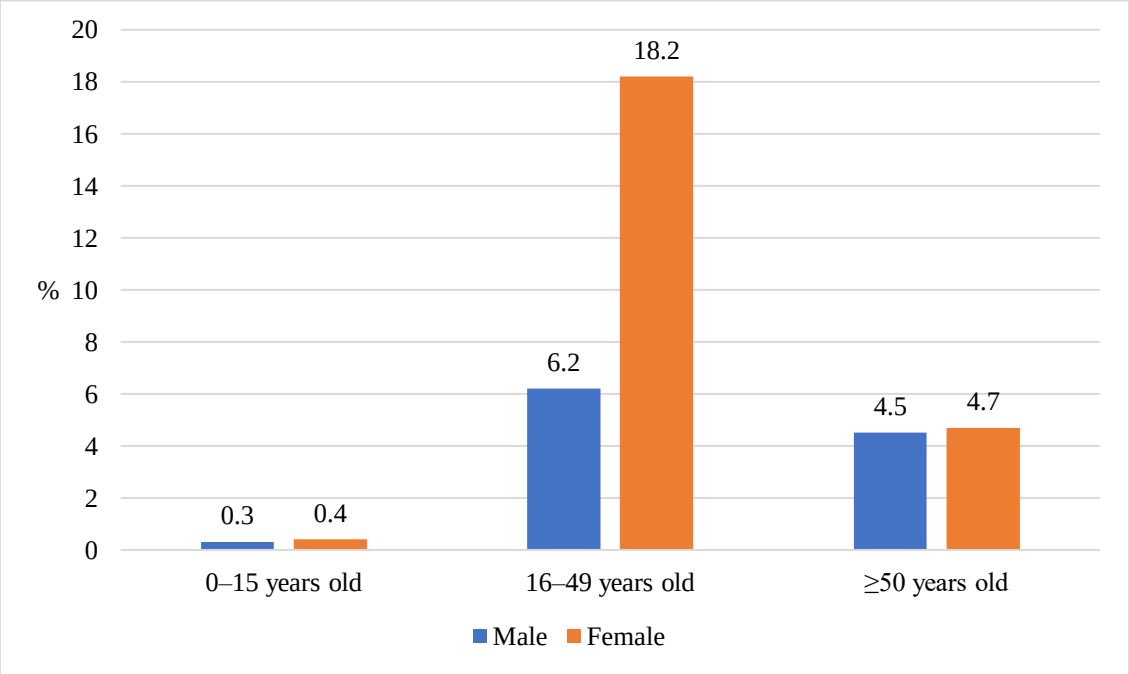

Figure 5. Percentage of people receiving health care services who were tested for HIV at least once according to age and gender, Estonia, 2018.

Out of all people who received health care in 2018, the largest proportion tested was among 16–49 year olds (12.6%) and the smallest proportion among 0–15 year olds (0.3%) (Table 11). In the age group of 16–49, the largest proportions of HIV tested people were in Ida-Virumaa and Harjumaa (15.8% and 14.5%, respectively). Among ≥ 50 year olds, the largest proportions of patients tested were in Ida-Virumaa and Tartumaa (6.6% and 5.7%, respectively). All in all, the largest proportion of people receiving health care services who were tested for HIV was in Ida-Virumaa – 8.8% (n = 10,572) (Table 11).

In Figure 6 there is a comparison of the percentage of people receiving health care services who were tested for HIV at least once according to age and region. The biggest proportion of tested were in the age group of 16–49, in Ida-Virumaa and Harjumaa (15.8% and 14.5%, respectively). Among ≥ 50 year old people, the largest proportion of tested was in Ida-Virumaa and Tartumaa (6.6% and 4.7%, respectively).

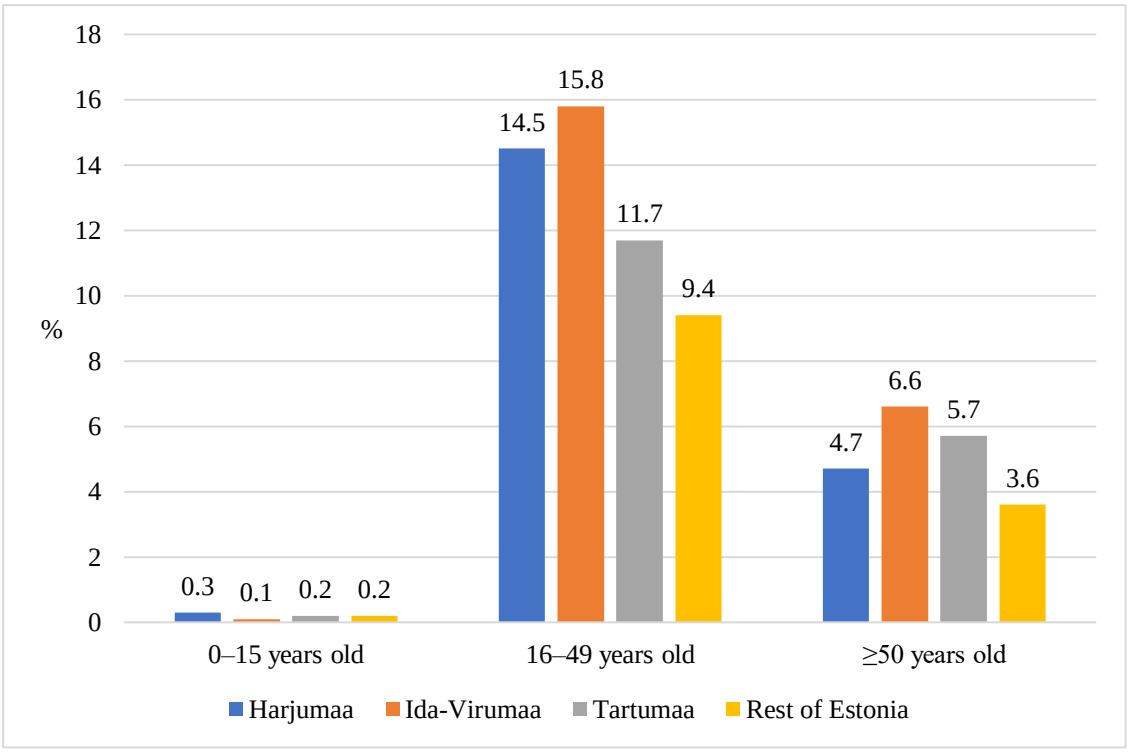

Figure 6. Percentage of people receiving health care services who were tested for HIV at least once according to age and region, Estonia, 2018.

4.1.5 People, who received healthcare services in primary care

The number of people, who received healthcare services in primary care, was 1,037,283 (Table 12). In general, 1.0% of them (n = 10,000) were HIV tested at least once. HIV testing was slightly higher among men than women (1.1% and 0.9%, respectively) (Table 12). In case of age groups, the largest proportion of tested was among 16–49 year olds (1.9%; n = 7511). In regions, the largest proportion tested was in Harjumaa and Ida-Virumaa (1.4% in both) (Table 12).

Comparing HIV tested persons in primary care by gender, the largest proportion of men who were tested was in Harjumaa and Ida-Virumaa (both 1.5%). Testing percentages among women in the same counties were 1.4% and 1.3%, respectively (Table 13).

The largest proportion of HIV tests for both men (1.9%) and women (1.8%) was among 16–49 year olds (Table 13).

Comparing HIV tested people regionally in primary care by age group, then 0–15 year olds were tested the most in Ida-Virumaa (0.2%). In the age group of 16–49, the largest proportion of HIV tested people was in Harjumaa and Ida-Virumaa (2.8% and 2.5%,

respectively). The largest proportion of tested among people older than 50 years was in Ida-Virumaa 0.9% and Harjumaa 0.7% (Table 14).

4.1.6 People, who received healthcare services by specialists

There were 875,755 people in total who received healthcare services by specialists (Table 15). Of them, 8.1% were HIV tested (n = 70,991). More women were HIV tested than men (10.4% and 4.8%, respectively). In case of age groups, the proportion of HIV tested was the largest among 16–49 years old (15.2%; n = 50,522). By regions, the largest proportion of tested patients was in Ida-Virumaa – 9.7% (n = 9296) (Table 15). Comparing HIV tested persons by gender and county, then the largest proportions tested were Ida-Virumaa (6.7% of men and 11.7% of women) (Table 16).

The largest proportion tested for HIV among both men and women, was in the age group of 16–49 year olds (7.1% and 20.8%, respectively) (Table 16).

In regions, the largest proportion tested for HIV among 0–15 year olds was in Ida-Virumaa (1.1%; n = 181). In the age group of 16–49, the largest proportion of tested was also in Ida-Virumaa (17.7%; n = 5685). Among people older than 50 years, the largest proportion tested was in Tartumaa and Ida-Virumaa, 7.3% and 7.2%, respectively (Table 17).

4.1.7 HIV tests

In 2018, in total 95,682 HIV tests were done in Estonian health care facilities. About three quarters of HIV tests (74.8%) were performed to women (n = 71,522) and nearly three quarters (73.9%) among people aged 16–49 years (n = 70,674). The largest proportion of all HIV tests was done in Harjumaa, which is 50.2% (n = 47,909).

In Figure 7 can be seen the proportion of HIV tests according to specialty of the doctor. Half of the treatment invoices with HIV tests belonged to gynecologists, which is 50.7% (n = 48,579) (Table 1). Of them 1236 were with ICs (2.5%) and 18,906 without ICs (38.9%) (Table 4), the rest were related to pregnancy monitoring (n = 28,437; 58.5%). Thereafter, the most treatment invoices with HIV tests belonged to internal diseases and primary care (14,223 (14.9%) and 10,235 (10.7%), respectively) (Table 1). The number of IC related treatment invoices with HIV tests among internal diseases was 838 (5.9% of all HIV tests) and among primary care 464 (4.5%) (Table 4). Regarding ICs, the largest

number of HIV tests with ICs were related to pregnancy monitoring, which is 28,875 (18.3%). Thereafter, infectious diseases and tumors (respectively 1684 (1.8%) and 1109 (1.2%)) (Table 2).

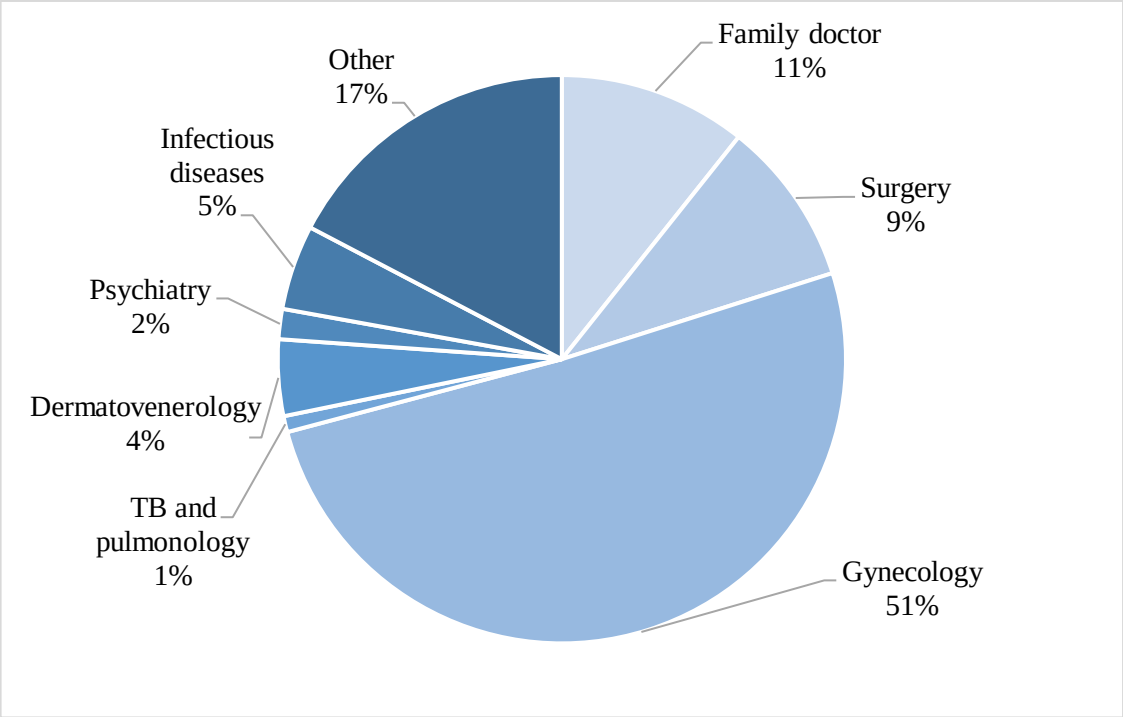

Figure 7. HIV tests according to specialty, Estonia, 2018 (%).

The number of invoices with HIV tests without pregnancy monitoring was 66,807 (Table 3). Almost two thirds of these HIV tests were performed among women (0.9%; n = 42,684), the rest among men (0.8%; n = 24,149). Of the 66,807 invoices with HIV tests, 3.0% among women (n = 2846) and 3.5% among men (n = 2067) had an IC.

Based on data of newly diagnosed HIV cases in 2018 from Health Board, the positivity rate of the tests was calculated. Only HIV cases diagnosed in health care setting were included. Cases diagnosed in prisons and among blood donors were left out. Anonymously diagnosed cases were included (even though these tests are not reported to EHIF), because they are reported to Health Board by health care institutions. Positivity rate of HIV tests by gender and age in different regions is presented in Table 18. The overall positivity rate was 0.2%. The highest proportions of tests found to be positive were among 16–49 year old men in Ida-Virumaa (1.2%) and in Tallinn and Harjumaa (0.6%). Among women, the highest proportion of tests found to be positive was in Ida-Virumaa, in the age group of 16–49 year olds (0.3%) (Table 18).

In 2018, primary care performed 10,235 tests and discovered 20 new HIV cases, thus the positivity rate was 0.2%. The highest proportion of tests found to be positive were among infectious disease specialty, 4624 HIV test were performed and 62 new HIV cases were discovered, therefore the positivity rate was 1.3%. In dermatology 4160 tests were done, six new HIV cases were discovered, positivity rate was 0.1%. In gynecology 48,579 tests were done, 12 new HIV cases were discovered, positivity rate was 0.02%. The number of pregnancy monitoring tests was 28,875 and seven cases were diagnosed among pregnant women, thus positivity rate of tests was 0.02%. In ED 10,167 HIV tests were done, out of them 13 HIV tests were positive (7% out of all HIV cases), positivity rate was 0.1%.

4.1.8 Comparison with previous years

For comparing the testing in 2018 with the data from 2012–2015 [36] testing was analysed among 15–49 years old people by regions. In Ida-Virumaa the proportion of HIV tested was bigger among men than women (9.1% and 21.7%, respectively). In Harjumaa the situation was similar – the percentage of tested among men was 7.4% and among women 19.6% (Table 19).

Also, specific IC were analyzed. Comparing HIV testing among 15–49 year olds by gender with herpes zoster (ICD-10 code B02), then bigger proportion of tested was among men (8.3%), than among women (4.9%). Patients in the age of 15–49 years, who had on one treatment invoice at least one STI diagnose (ICD-10 codes A51–A64), were all together 3942. Among men were tested 20.8% and among women 11.9% (Table 20).

Comparing HIV testing with infectious mononucleosis (ICD-10 code B27) by gender among 15–49 years old, then 26.8% men and 20.2% women were tested (Table 20).

5. Discussion

The importance of HIV testing is expressed in many ways. Early detection of HIV reduces further spread of the infection. Also, diagnosing people as soon as possible grants access to treatment, which noticeably decreases associated morbidity and mortality [30].

For public health, HIV status awareness is vital, because it reduces risk behavior [28]. In USA approximately 20% of PLHIV are unaware of their HIV infection [39], [40]. An estimated 49% of transmissions are from the 20% of PLHIV unaware of their infection – thus people unaware of their HIV infection contribute considerably more to the further transmission of HIV. Approximately eight additional infections could be averted per 100 newly diagnosed HIV infection cases [40].

In the US, The Centers for Disease Control and Prevention statement is that about 75% are aware of their HIV infection and 25% are unaware. Based on these two groups, sexual HIV transmission was estimated from persons aware and unaware of their HIV infection. The results show that HIV transmission through sex in unaware group was 3.5 times higher than among those who were aware of their HIV infection [39].

Late HIV infection diagnosis also leads to worse reaction to ART treatment, increased HIV related mortality and morbidity, increased healthcare expenditure [29]. HIV infection entails various direct and indirect costs for the infected person themselves and for the society at large. The biggest expense for PLHIV comes primarily from deterioration in quality of life due to poor health, which also results in reduction in working capacity and related income. The most important costs for the rest of society are the costs of medicines and health care, loss of added value not provided by PLHIV due to reduced work capacity and shorter life expectancy, and also the cost of various social system benefits and services. HIV treatment is effective but costly [41]. In Estonia, the total cost of ARV drugs has increased year by year. In 2014, the total cost of ARV treatment for the state was 11.4 million euros, in 2015, already 12 million euros [41].

In Estonia, it is estimated that approximately 900 people are still unaware of their HIV infection [42]. According to the Health Board, 539 cases of AIDS have been diagnosed

over the years. In 2018, there were 25 cases of AIDS. Eleven of these AIDS cases were diagnosed within three months of HIV diagnosis. It means that in 2018 6% of newly diagnosed HIV cases were discovered very late – in AIDS stage. This proportion has increased a little over the years [34]. It is very important to raise awareness among people of their HIV status and also educate how to prevent it. It is necessary to raise the proportion of people who are not aware of their HIV status and start ART treatment as soon as possible.

Estonian HIV action plan for 2017–2025 also addresses the issue of awareness of HIV status. The main goal of Estonian HIV action plan is to stop the widespread of HIV infection. In addition to reducing new cases, it also aims to achieve the goals that are targeted by United Nations AIDS Program and WHO by 2020, the so called 90–90–90 goals:

- 90% of all HIV infected people are aware of their infection;
- 90% of all people diagnosed with HIV infection receive ARV-treatment;
- 90% of all people receiving ARV-treatment have viral suppression [33].

National HIV action plan confirms that HIV testing has been limited, despite the fact that there are no budgetary limits on conducting HIV testing according to the national guidelines (i.e. testing is also guaranteed for people without health insurance). It stresses that HIV testing is a priority and one of the indicators of the successful implementation is reduction in the proportion of late diagnoses [33].

Thus, the main aim of the study was to evaluate HIV testing in Estonian health care system in 2018. The analysis was based on data from Estonian Health Insurance Fund database on treatment invoices. The main aim of the study was accomplished. All the results of this analysis also confirm that HIV testing in Estonia needs to be improved. The novelty of this work is that it is the first analysis in Estonia that includes case-based data of all treatment invoices and all patients who have received health care. It was possible to compare all patients who were tested for HIV to those who were not tested. In previous work, 15–49-years old patients only from Harjumaa and Ida-Virumaa were studied, now all Estonian population was included [36]. Also, instead of a few selected HIV ICs, all ICs were analysed [35].

5.1 HIV testing in 2018 and comparison with previous years

The results show that the biggest proportion of HIV tested patients was in the age group of 16–49 and in Harjumaa and Ida-Virumaa region. According to gender, a bigger proportion was tested among women than men. Patients aged 0–15 years were tested the most in Ida-Virumaa. Historically, in Ida-Virumaa HIV-prevalence among pregnant women has been very high (2%) [43], thus HIV testing among children may be related to prevention of MTCT.

More than half of HIV tests in 2018 were performed by gynecologists and midwives (50.7%). Among them the proportion of invoices with HIV tests was 9.6%, this includes pregnancy monitoring. In Estonia, from the year of 2000, pregnant women are recommended HIV testing twice during pregnancy. Among women, the number and proportion of cases where HIV was first detected during pregnancy has decreased (in 2010 30 new cases, in 2018 7 new cases) [34]. Based on this, double testing during pregnancy may not be necessary. If women have reliable partners, and there is no need for blood transfusions, it is not necessary to do HIV testing twice. In 2014, WHO made an evaluation report about HIV/AIDS treatment and care in Estonia. The removal of the second HIV test during pregnancy was recommended, while it is not cost-effective and not recommended by WHO in general [34], [44]. The results from this study also support it – in 2018 positivity rate of pregnancy related tests was 0.02%. Even if every pregnant woman was tested twice then the positivity rate of women would have been below 0.1% (threshold for cost-effectiveness) [26].

The biggest proportion of invoices with HIV tests was from infectious disease specialists (11.4%), who also diagnose the largest number of new HIV cases. Among gynecologists, the proportion of invoices with tests was 9.6% (which includes pregnancy monitoring), and among tuberculosis specialists 3.6%. As tuberculosis care and treatment may last 9–12 months, one patient may have many invoices and thus the testing rate of patients is higher. Data from the National Tuberculosis Registry indicates that the percentage of new and relapsed tuberculosis cases who have been tested for HIV has increased from 91% in 2005 to 96% in 2013 [35].

HIV-testing in case of opiates use was low in health care system. Other studies reveal that HIV testing is very high among PWID [19] and thus these patients may not need testing as they are already HIV-infected. On the other hand, PWID are still very important risk

group in Estonia [19] and HIV testing among them is very cost-effective, HIV-negative PWID could be tested even every month [45]. Therefore, regular testing of HIV-negative people with opiate use disorders is definitely important.

In 2018, in the ED 10.6% of all HIV tests were done, which is very big proportion of HIV tests. The positivity rate in ED was 0.1%. The Estonian HIV testing recommendations suggests that HIV testing in ED should be provided according to clinical indications [19]. In 2014–2015, there were 21 new HIV cases detected in ED. Two years before HIV diagnosis 1% of newly diagnosed HIV cases had visited ED [27]. Based on this, HIV testing should be done to all high-risk patients who visit EDs with their concerns. Especially because ED provides health care services to all uninsured, socially excluded people or to patients with no access to primary care services. HIV screening in ED could be good for public health and for the patient, because of the early detection of HIV infection (which would prevent morbidity and mortality) and also could be cost-effective in the long run. However, ED is already overcrowded with patients with different concerns and HIV screening would be an additional burden on them. In the US, approximately 0.3% of all ED visits include HIV testing. In 2010, a first time HIV testing of nontargeted opt-out screening was done in EDs in the US. The study period was approximately 30-months. 71,556 patients presented to the ED, of whom 27,952 were HIV tested (39%). Of them, 78 (0.3%) patients confirmed positive results. Out of the 78 patients 18 (23%) identified with acute HIV infection [46].

In the US between October 2008 and October 2009, an evaluation of opt-out inpatient HIV screening was conducted at an Urban Teaching Hospital in California, San Diego. The aim of this study was to value an opt-out inpatient rapid HIV screening program delivered by ED physicians. In this study 11,398 patients between the age of 13–63 years were included. Of them, 74% were suitable for opt-out HIV screening program. The testing was offered to 36% of them and only half agreed to test. 90% of them were tested patients. Other 148 patients who were not tested, were discharged or unavailable for phlebotomy. Out of 1389 patients, six patients were diagnosed with HIV infection. In five out of six patients HIV infection was detected in ED. Physicians should be required to perform more HIV tests [47].

Comparing HIV testing among 15–49 years old people in 2012–2015 and 2018, in Harjumaa among men, the proportion of HIV tested has risen slightly, from 3.5% to 7.4%. Comparing HIV testing among women, then the proportion of tested people has also slightly risen from 12.2% in 2012 and 14.8% in 2015 to 19.6% in 2018. Looking at HIV testing in Ida-Virumaa by gender, then compared with previous years testing has increased less among men than women. Among men, 5.0% were HIV tested in 2012, 6.4% in 2015, and 91.% in 2018. Among women, in 2012 13.8%, in 2015 17.7% and in 2018 21.7% were tested. In Ida-Virumaa, testing rates remain somewhat higher than in Harjumaa [36]. Ida-Virumaa is a smaller county population-wise compared to Harjumaa, and may be able to address patients' testing better. Ida-Virumaa has always had the highest number of HIV cases per 100,000 population, therefore it is good that in Ida-Virumaa, the third largest county in Estonia, HIV testing is maintained at a higher level. Harjumaa county could also learn from this. However, both counties still need to be more effective with HIV testing among patients.

According to HIV testing recommendations, in case of an IC, every person should be tested, regardless of age [19]. Comparing HIV testing in case of herpes zoster among 15–49 years old in 2012–2015 with 2018, among both genders there has been a slight increase – among men from 4.7% in 2015 to 8.3% in 2018, and among women from 2.5% in 2015 to 4.9% in 2018 [36]. The results show that the proportion of tested among men was higher than among women in case of herpes zoster. Therefore, testing for both genders should be further enhanced among healthcare professionals.

Comparing HIV testing in case of STIs among 15–49 years old in 2012–2015 and 2018 the testing hasn't changed significantly over the years. Among men, the proportion of tested was bigger, in 2012 17.9%, in 2015 18.3%, and in 2018 20.8%. Among women, the proportion of tested was 8.7% in 2012, 13.0% in 2015, and 11.9% in 2018 [36]. HIV testing with STIs is more common among men, which could be related to MSM and the higher risk among them. Among women, HIV testing with STIs has more or less stayed the same, because risk behaviors may be lower compared to men. It may also be due to doctors' opinion that women behave less risky than men. Although HIV testing has risen slightly, it should be more effective.

HIV testing in infectious mononucleosis among 15–49 years old patients has decreased in 2018 among both genders, compared to 2012–2015. In 2012 among men 34.2% were

tested, in 2015 35.6% and in 2018 26.8%. Among women 29.4% in 2012, 27.0% in 2015 and 20.2% in 2018 were tested [36]. The symptoms of infectious mononucleosis resemble primary HIV infection, therefore HIV testing may help to diagnose HIV in a very early stage [2], [12].

In 2016 the number of HIV tests was 71,008, in 2017 86,592 [37], and in 2018 95,682. Thus in three years, HIV testing has grown 34.7%.

Comparing treatment invoices with HIV tests in 2016–2018 based on the main specialty, then almost half of HIV tests in all these years have been performed by gynecologists and midwives [37]. This testing is largely linked to pregnancy monitoring, which according to the Estonian HIV testing recommendations must be done twice during pregnancy [19].

Comparing treatment invoices with primary diagnosis of HIV IC, then the highest number of invoices in both 2016, 2017, and 2018 was related to pregnancy monitoring. Also, looking closely at treatment invoices with HIV tests with infectious disease diagnosis, the number increased in 2017 compared to 2016, and fell again in 2018, from 2.1% to 1.8% [37]. The changes in the number of tests may be related to the number of cases of the specific conditions/diseases which change a little over the years. The changes in the number of tests may also be affected by the specialists' awareness of the patient's previous HIV testing and HIV diagnosis and risk factors, thus they do not consider it necessary to test for HIV infection just in case.

By gender, the number of tests among both men and women has increased over the three years. Taking a closer look at HIV IC presence in treatment invoices with HIV test among women, then the proportion of such invoices has decreased a little bit, from 4.6% in 2016 to 4.0% in 2018. Among men, the proportion has also decreased, from 12.4% in 2016 to 8.6% in 2018 [37]. Thus it could be concluded that the increase in HIV testing is not related to the increased testing in case of ICs.

5.2 HIV testing practices based on the specialty of the doctor

Another aim was to compare **HIV testing practices based on the specialty of the doctor**.

Comparing treatment invoices among primary care and specialist doctors, there were almost half a million more treatment invoices from primary care. However, compared to the coverage of HIV tests in treatment invoices, then 0.2% of primary care and 2.2% of specialist doctors' invoices had HIV tests. The number of patients receiving health care services was also higher in primary care. Only 1.0% of them had HIV test at least once, including in Harjumaa and Ida-Virumaa. However, 8.1% of patients visiting specialist doctors were tested at least once. Among primary care, the bigger proportion of tested were men, however by specialists – women (largely related with pregnancy monitoring). Although the primary exposure of patients with health care services is usually primary care, the proportion of HIV tested patients in primary care is very low. Higher proportion of HIV testing among men can be related to their risk behavior (for example MSM and male PWID). Women have less risk behaviors than men, so fewer HIV tests are likely to be performed. Regardless of risk behavior, both women and men should be tested according to HIV testing recommendations.

Both in primary care and among specialist doctors, the bigger proportion of tested was among 16–49 years old. Comparing by the region, primary care tested equally in Harjumaa and Ida-Virumaa, while specialists tested more in Ida-Virumaa. In Estonian HIV testing recommendations, it is recommended to test people in the age of 16–49 years in Harjumaa or Ida-Virumaa. The results of the analysis show that doctors generally follow these requirements, which is good.

Based on the findings of this research, it could be stated that primary care specialists test too little for HIV infection despite unlimited funding for HIV testing since 2017. Since family doctor monitors peoples' health throughout their lives and treats various diseases, it is extremely important to know, who is infected with HIV. There may be several reasons for low testing in primary care. In 2017, a study about attitudes and needs related to HIV infection was conducted among Estonian family doctors and residents [48]. Till 2017, the resources for HIV testing were limited, but there are also subjective reasons for not testing patients for HIV. One third of the respondents (36%) said that the main

obstacle of HIV testing was funding/lack of resources. 7% of the respondents thought that it was related to the patients' prejudice and delicacy of the topic. 12% of participants found that language problems prevented them from offering HIV testing to some patients. Other mentioned obstacles included the lack of suitable patients for HIV testing in the family doctors list (8%) and already very high workload (7%). One of the recommendations of the study was to provide HIV-related training to family doctors [48].

In the Southeastern US a systematic review was conducted about healthcare providers' perceived barriers and facilitators to testing for HIV at poorly used testing sites. Barriers to HIV testing included financial barriers (such as financial burden on clinics, availability of funding), guideline conformity with practice, and HIV related stigma [49].

Different interventions have been implemented in order to improve HIV testing in primary care. In Estonia, a quasi-experimental study about HIV indicator disease-guided testing was done from October 2017 to April 2019. The results were analysed before and after intervention. The study was performed in three family doctor centers located in Tallinn. The results show that compared to pretest and posttest, the number of HIV tests increased fourfold. In pretest phase (October 2017–April 2018) all together 104 HIV tests were done among three primary health centers. In posttest phase (October 2018–April 2019) with HIV decision support system 441 tests was done [50].

In the US, it is recommended that all adults through the age of 65 need to be screened at least once for HIV. In January 2012 till October 2014 an electronic medical record reminder was created for primary care practice. The screening rates were assessed before and after implementation to evaluate the impact of the electronic reminder on rates of screening for HIV. After the implementation of electronic reminder, HIV testing increased two-fold, from 15.3% to 30.7%. The largest effect with HIV testing reminder had in the age group of 46–65 (from 9.7% to 27.2%). The biggest proportion of tested were in the age of 26–35 (36.9%). Before the intervention, the positivity rate of HIV tests was 0.3%, as compared to after the implementation, the positivity rate was 0.7%. Before the implementation of electronic reminder women were less likely to be tested than men (14.0% and 17.3% respectively). After the implementation, the impact of the reminder was again larger for women than men (testing increased 2.2 times among women and 1.8 times among men). Even though HIV screening increased in primary care practices to

30.7% by using electronic reminders, the practices overall compliance to HIV screening guidelines stayed low [51].

In 2015 a prospective study was conducted in Barcelona among three primary health care physicians, about HIV testing with the implementation of an electronic prompt. The study included 18–65 years old patients without HIV infection. The results were compared with the 2013 (pre-prompt) and 2016 (post-prompt) data. The electronic prompt was working 10 months during which 832 patients who had at least one IC went to one of the three physicians. Out of 832 patients, blood test was done to 238 patients. The results show that in 2013 the proportion of HIV tested ICs was 12.6% and it increased in 2015 almost three times to 35.6%. In 2016 (post-prompt period), HIV testing fell to 17.9%. An electronic prompt implementation could increase the number of HIV testing among physicians [52].

5.3 Evaluation of the implementation of the national HIV testing recommendations

According to Estonian HIV testing recommendations, it is recommended to test **all people who have HIV ICs [19].**

The results show that in total one-tenth of treatment invoices with ICs included HIV test. As in the same treatment case patient could have several treatment invoices, then the actual proportion of ICs HIV tested could be more than 10%. If pregnancy related HIV testing was excluded (which is on very good level), then the proportion of HIV tested with ICs was only 3.2%.

Besides pregnancy, the largest proportion of ICs tested for HIV were STIs (9.8%). Comparing different specialties according to HIV testing in case of ICs, then infectious diseases, tuberculosis, and gynecology specialties tested the most. According to regions, in Harjumaa and Ida-Virumaa the ICs were tested the most for HIV. Comparing age groups, then the most ICs tested were in the age of 16–49 years. Although IC based testing recommendations apply to all age groups, the proportion of ICs tested was lower among people older than 50 years of age.

In case of ICs, the results show that infectious diseases specialty, compared with other specialties, test the most patients with tumors, infectious diseases, STI, pneumonia, skin

diseases, symptoms, and pregnancy. Testing for them have been the highest for different ICs, in order to exclude HIV infection among different ICs. Among gynecologist and midwives, besides pregnancy, the most tests were done in case of opiates use disorders and STIs. In surgery, the most HIV tests were performed with patients with tumors.

According to Estonian HIV testing recommendations, **in Harju County, including Tallinn, and Ida-Viru County, all in- and out-patients aged 16–49 years** are recommended to be tested for HIV [19]. The results reveal that in both Ida-Virumaa and Harjumaa less than one-fifth of patients aged 16–49 years were tested in 2018 at least once. However, testing recommendations does not recommend testing everybody in this group every year. Thus, the cumulative proportion of people HIV tested over the years among those aged 16–49-years in Harjumaa and Ida-Virumaa is probably higher and the testing coverage even better.

This work shows that compared to Estonian HIV testing recommendations the actual proportion of tested people is still very low. The most deficiencies are among patents in high risk groups – patients with ICs need to be more tested. The analysis showed that a large part of testing is related to pregnancy monitoring among women, however it is very important to increase HIV testing among other important ICs, too. Also, 16–49 years old patients, who live in Harjumaa or in Ida-Virumaa, should be tested more rigorously. Especially because those are the largest counties in Estonia with a larger population, where the prevalence of HIV is higher.

5.4 HIV testing comparison with other countries

Comparing HIV testing with EU/EEA countries, Estonia and France test equally the most (respectively 85.3 and 86.6 per 1000 population). Compared to Estonia, neighboring countries Latvia and Lithuania perform significantly less HIV testing. Looking at HIV testing in non-EU/EEA countries, twice more HIV tests are done in Russia, Kazakhstan, and Belarus compared to Estonia and France [17].

In France, there are about 140,000 PLHIV and of them 30,000 people are unconscious of the infection (21.4%). Each year 6000 to 8000 new HIV positive people are diagnosed. Out of them one-third in AIDS stage. In 2006–2013 in France mass screening policy on HIV testing was implemented and coordinated by general practitioners which gave a

significant impact on HIV testing rates in France. Within the study period, the rates of HIV testing increased during the GP visit from 3.3% in 2010 to 20.4% in 2013. This kind of mass screening give a positive effect on individual and public health outcomes [53]. In comparison, in Estonia 1.0% of patients visiting family doctors are tested for HIV. Estonia could also follow the example of France and carry out mass screening among patients through primary care. Subsequently, testing could also be compared with previous years and the number of new HIV cases. Similar testing would also give doctors more awareness of the importance of HIV testing. Such testing could also provide a positive effect on public health outcomes.

In Switzerland, many PLHIV are diagnosed late. Since 2007 by the Federal Office of Public Health has published HIV testing recommendations. The recommendations for HIV testing have been updated in 2010, 2013, and 2015. The recommendations published in 2013 differed in many ways. Testing indications were graded such that, firstly HIV testing is recommended for people with HIV ICs, AIDS defining conditions, acute HIV infection, and people who are at risk of acquiring HIV. Secondly, patients who are going through immunosuppressive therapy, a group to whom propose HIV testing. Thirdly, failure to take HIV test when needed, could have medical consequences. A retrospective analysis was conducted between 2012 and 2015 in a Swiss university hospital, to compare the local interventions on HIV testing practices and effect of national HIV testing recommendations. 147,884 patients were seen during the 4-year period study out of whom 9653 (6.5%) were tested. The results show that after new recommendations, the testing rate during the 4-year study period increased from 5.6% to 7.8%. The testing rates increased the most in ED, from 4.2% to 5.6% and in oncology, from 3.8% to 23.6%. Less testing was performed in the age of < 50 years and among women. This kind of research proves, that HIV testing can be improved by thoroughly designed recommendations [54].

5.5 Recommendations

This work revealed that there are still some shortcomings and discrepancies in everyday medical practice compared to the Estonian HIV testing recommendations. The following changes could make HIV testing more efficient and precise in Estonia (for both outpatient and inpatient care):

- It is recommended to test people with ICs as they are in the groups with a higher probability of HIV infection [30]. The results of this study show that the proportion of HIV tested people with ICs is very low. The results of this work show that compared to other specialties, infection disease specialty doctors tested the most of patients with different ICs. As shown in three studies, HIV testing electronic prompt in primary care increases testing among primary care 3–4 times, and this may be considered as a tool for electronic medical records for increasing testing rates [50], [51] [52].
- In Harjumaa, including Tallinn, and Ida-Virumaa, all in- and out-patients aged 16–49 years are recommended to be tested for HIV. Older and younger patients are recommended to be tested according to risks and ICs.
- Since primary care is the most likely point of contact with health care, much more testing should be done there. Testing should be guided, in particular, by the recommendations of HIV testing recommendations [37].
- All pregnant women should be tested once not twice during pregnancy. The analysis of the work revealed that the biggest proportion of HIV tests are performed in pregnancy monitoring with very low number of positive test results. Also, WHO recommends too, the second HIV test during pregnancy could be removed [44].
- Provide HIV testing to all patients with suspicion of an STI and other infectious diseases. As shown by various studies, risk behavior increases the risk of infection. With STIs only 9.8% were tested. It should be noted that among tuberculosis cases is HIV testing in Estonia very high, from 91% in 2005 to 96% in 2013 [35].
- Patients in addiction treatment and rehabilitation programs should be tested more. The results of this study showed that HIV testing of patients with opiates use disorders was very low. By specialty, the biggest proportion of HIV tests with opiates ICs were tested among gynecology specialty.
- Informing different specialists of the importance of HIV testing is also necessary. Various trainings on the importance of HIV testing should be provided. Also, the importance of HIV testing could be explained and taught already in basic education in university and medical schools.

5.7 Limitations

There are different limitations to the analysis. The main function of EHIF database is to monitor health care costs. The coding systems used in the invoices (the list of health care services coding and ICD-10) may not reflect everything related to the visit and the services provided.

- Main diagnosis on the invoice (based on ICD-10) may not exhaustively reflect the reasons for receiving health care. For example, there may be several comorbid diagnoses on the treatment invoice and the secondary diagnosis may have been the ICs for HIV testing (for this analysis, secondary diagnosis codes were not available). Therefore, the proportion of HIV tests performed in case of ICs may be higher.
- The list of ICs may not be exhaustive. HIV in Europe guidelines [26] were used for the purpose of this analysis.
- ICs may be incorrectly marked on treatment invoices. For example, the initial diagnosis may not have been precise (more general codes may have been used, or codes like Z03 – medical observation and evaluation for suspected diseases and conditions) and the health care professional forgets to change it before submitting the invoice to EHIF. Subsequent analyzes will therefore result in incorrect results.
- HIV tests can be marked incorrectly. In earlier years, EHIF's list of health care services had the same code for hepatitis B and hepatitis C tests as for HIV test. The code was changed, but the price is the same. Thus it is possible that health care workers may use the old code. Thus analyzing HIV testing, inaccurate results may occur and less HIV test were reported than actually performed.
- Also, all treatment invoices do not reflect a real encounter with the patient (some may have been about phone or e-mail consultation), and thus there was no possibility to even offer HIV testing. Unfortunately, the data on the type of the visit was not available. Therefore, the proportion of visits and patients HIV tested, may have been higher.
- People may have had several invoices for one sickness episode (for example tuberculosis, viral hepatitis). The abundance of treatment invoices may cause confusion and the actual testing rate of patients may be higher.
- There is no information about the proportion of patients, who refuse to test (such code does not exist, that could be marked on treatment invoices). In the presence

of a refusal code, it would be a bigger overview, how many health care workers have offered HIV testing to patients.

- There is no information about the proportion of patients for whom the doctor already knew that they had been recently tested or that they were already HIV-infected. The national HIV testing recommendations does not recommend testing at every single visit, but rather, on specific indications. In some cases, not testing may have been a choice of the doctor and/or patient based on previous testing of the patients.
- There is no information about health care services paid by patients themselves. These treatment invoices and information on HIV testing will not reach EHIF. It can be hypothesized that if people have to pay for testing themselves, they are tested less.
- There is also a lack of data about HIV tested patients in anonymous testing sites and prisons. These data do not include testing among blood donors, too. Thus these data do not reflect all HIV testing in Estonia.

Despite all these limitations, the analysis provides valuable information on HIV testing practices in Estonia. This is a unique study in Estonia, because it includes all treatment invoices and all patients who have received health care.

5.8 Further research suggestions

Ideas for further be analyses include:

- Analysis of data based on the health care visit type – ambulatory, stationary, or an emergency care visit (excluding all e-mail and phone visits).
- Including information of all diagnoses listed on one invoice, to get a better overview of the diagnoses leading to testing and also missed cases of IC based testing.
- Analyzing data over several years to see determine more precisely how large proportion of Estonian people visiting health care have been tested and how big proportion of people are tested several times (for example, women may have 2–3 children over a few years and thus tested even 4–6 times in the same period).
- As the proportion of people tested with ICs was very low, it may be needed to organize a clinical audit based on real patients' records to verify this.

6. Summary

In EU, Estonia is in the second place with regards to newly diagnosed HIV cases – 14 cases per 100,000 population in 2018 (ECDC 2018). Since 1988, more than 10,000 HIV cases have been diagnosed in Estonia (Health Board). It is estimated that about 900 people are still unaware of their HIV infection [42]. Comparing HIV testing in Estonia with other EU/EEA countries, then Estonia is one of the countries, with the highest testing rates (85.3 per 1000 population). For example, compared to neighboring countries Latvia and Lithuania HIV testing rate in Estonia is two times higher.

The main aim of the thesis was to evaluate HIV testing in Estonian health care system in 2018. More specifically, to analyze how well the national HIV testing recommendations are being implemented, which patients were tested for HIV in 2018 and which were not, and to compare HIV testing practices based on the specialty of the doctor.

The study was designed as an observational retrospective quantitative study. Data were collected from Estonian Health Insurance Funds medical invoice database, in the year of 2018 (included insured and not insured patients). All treatment invoices were analyzed based on the patient's gender, age, living place, specialty of the practitioner who had issued the invoice, the primary diagnosis, and HIV testing. The diagnoses on treatment invoices were, on the basis of ICD-10, categorized as HIV indicator conditions as recommended by the Copenhagen HIV programme. All data were analysed using MS Excel and STATA 14.

In 2018, EHIF had 8,086,507 treatment invoices, out of which 1.1% (n = 95,682) included HIV test. More than a half of those treatment invoices belonged to primary care, but only 0.2% of primary care invoices included HIV test. Bigger proportion of invoices with HIV tests was among different specialties (2.2%), although patients usually have their first contact with primary care.

In Harjumaa and Ida-Virumaa less than one-tenth of patients were tested (7.9% and 8.8%, respectively). In case of age groups, the biggest proportion tested was among 16–49 years old (12.6%). Women were tested more than men (9.1% vs 4.3%). HIV testing in case of HIV indicator conditions (pregnancy monitoring excluded), was only 3.2%. Among specialties, infection diseases doctors tested the most in case of indicator conditions (17.9%).

Comparing HIV testing in 2018 with previous years, then there haven't been major changes. Comparing years 2016–2017 and 2018, the number of HIV tests has risen 34.7%. At the same time, the proportion of HIV-tested ICs and people aged 15–49 in Harjumaa and Ida-Virumaa has not considerably increased. In all years, the biggest proportion of tests have been performed by gynecologist and midwives, mostly in relation to pregnancy monitoring.

In conclusion, the author suggests promoting HIV testing importance among primary care doctors and specialists. The more rigorous and thorough HIV testing is in health care system, the better we could control the spread of the infection.

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Appendix – List of tables

Table 1. All treatment invoices according to HIV-testing by specialty, Estonia, 2018.

Specialty	HIV-tested		HIV-untested		Total	
	n	%	n	%	n	%
Primary care	10,235	0.2	4,255,002	99.8	4,265,237	100
Specialist care	85,447	2.2	3,735,823	97.8	3,821,270	100
Otorhinolaryngologist	264	0.2	176,713	99.8	176,977	100
Surgery	8995	1.3	661,970	98.7	670,965	100
Gynecology	48,579	9.6	455,356	90.4	503,935	100
Tuberculosis	194	3.6	5156	96.4	5350	100
Pulmonology	678	0.9	69,895	99	70,573	100
Dermatovenerologists	4160	2.4	172,477	97.6	176,637	100
Pediatrics	122	0.1	128,319	99.9	128,441	100
Psychiatry	1642	0.6	254,013	99.4	255,655	100
Infectious diseases	4624	11.4	36,085	88.6	40,709	100
Internal diseases	14,223	2.3	610,008	97.7	624,231	100
Oncology	1624	0.9	184,402	99.1	186,026	100
Other	342	< 0.1	981,429	99.9	981,771	100
Total	95,682	1.2	7,990,825	98.8	8,086,507	100

Table 2. All treatment invoices according to HIV testing by HIV indicator conditions, Estonia, 2018.

HIV indicator condition category	HIV-tested		HIV-untested		Total	
	N	%	n	%	n	%
None	61,892	0.8	7,713,094	99.2	7,774,986	100
Indicator conditions, including	33,790	10.8	277,731	89.2	311,521	100
Tumors	1109	3.9	27,099	96.1	28,208	100
Infectious diseases	1684	5.2	30,573	9.5	32,257	100
STI	596	9.8	5504	90.2	6099	100
Pneumonia	651	3.3	19,021	96.7	19,672	100
Hematopoietic diseases	28	6.5	406	93.5	434	100
Skin diseases	433	1.5	28,638	98.5	29,071	100
Nephrology	0	0	21	100	21	100
Neurology	273	0.8	33,354	99.2	33,627	100
Symptoms	129	3.9	3107	96.0	3236	100
Opiates	13	0.9	1422	99.1	1435	100
Pregnancy	28,875	18.3	128,586	81.7	157,461	100
Total	95,682	1.2	7,990,825	98.8	8,086,507	100

Table 3. All treatment invoices (except pregnancy monitoring) according to HIV testing in case of HIV indicator conditions* by gender, age group and region, Estonia, 2018.

	Treatment invoices with indicator conditions*			Treatment invoices without indicator conditions			Total		
	N**	n***	%	N	n	%	N	n	%
Total	**154,060**	**4915**	**3.2**	**7,774,986**	**61,892**	**0.8**	**7,927,697**	**66,807**	**0.8**
Gender (in 104 cases gender unknown)									
Male	59,355	2067	3.5	3,090,115	22,082	0.7	3,149,475	24,149	0.8
Female	94,703	2846	3.0	4,684,771	39,802	0.9	4,779,474	42,648	0.9
Age group (years) (in 1118 cases age unknown)									
0–15	9623	52	0.5	1,504,632	694	< 0.1	1,514,255	746	< 0.1
16–49	67,404	3187	4.7	2,293,708	38,647	1.7	2,361,112	41,834	1.8
≥ 50	77,016	1670	2.2	3,975,555	22,501	0.6	4,052,571	24,171	0.6
Region (in 2699 cases region unknown)									
Harjumaa	67,481	2335	3.5	3,339,967	31,377	0.9	3,407,448	33,712	1.0
Ida-Virumaa	17,475	703	4.0	853,955	9473	1.1	871,430	10,176	1.2
Tartumaa	17,729	570	3.2	951,445	6692	0.7	969,174	7262	0.7
Rest of Estonia	51,008	1279	2.5	2,611,659	14,012	0.5	2,662,267	15,291	0.6
Other****	53	10	18.9	2608	141	5.4	2661	151	5.7

*Indicator condition and diseases, except pregnancy monitoring, which have been left out

**All invoices

***Invoices with HIV-test

****Foreign, place of residence unknown

Table 4. All treatment invoices according to HIV testing in case of indicator conditions* by specialty, Estonia, 2018.

	Treatment invoices with indicator conditions			Treatment invoices without indicator conditions			Total		
	N**	**n*****	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Primary care	54,603	464	0.9	4,206,542	9360	0.2	4,261,145	9824	0.2
Otorhinolaryngologist	215	1	0.5	176,760	263	0.2	176,975	264	0.1
Surgery	8097	192	2.4	662,614	8798	1.3	670,711	8990	1.3
Gynecology and obstetrics	19,126	1236	6.5	335,226	18,906	5.6	354,352	20,142	5.7
Tuberculosis	990	141	14.2	4360	53	1.2	5350	194	3.6
Pulmonology	3283	250	7.6	67,290	428	0.6	70,573	678	1.0
Dermatovenerologists	19,728	556	2.8	156,860	3587	2.3	176,588	4143	2.3
Pediatrics	1451	18	1.2	126,986	104	< 0.1	128,437	122	0.1
Psychiatry	1021	4	0.4	254,634	1638	0.6	255,655	1642	0.6
Infectious diseases	5447	975	17.9	35,253	3647	10.4	40,700	4622	11.4
Internal diseases	26,637	838	3.2	594,201	13,382	2.3	620,838	14,220	2.3
Oncology	10,166	228	2.2	175,825	1396	0.8	185,991	1624	0.9
Other****	3296	12	0.4	978,435	330	< 0.1	981,731	342	0
Total	154,060	4915	3.2	7,774,986	61,892	0.8	7,929,046	66,807	0.8

*Indicator condition and diseases, except pregnancy monitoring, which have been left out

** All invoices

***Invoices with HIV-test

****Foreign, place of residence unknown

Table 5. Primary care (family doctor's) treatment invoices with HIV indicator condition and HIV tested persons, Estonia, 2018.

Diagnosis	HIV tested		HIV untested		Total	
	n	%	n	%	n	%
None	9360	0.2	4,197,182	99.8	4,206,542	100
Tumors	8	0.2	4534	99.8	4542	100
Infectious diseases	214	1.7	12,745	98.4	12,959	100
STI	25	2.6	945	97.4	970	100
Pneumonia	83	0.7	11,243	99.3	11,326	100
Hematopoietic diseases	3	2.9	102	97.1	105	100
Skin diseases	25	0.2	11,157	99.8	11,182	100
Nephrology	0	0	13	100	13	100
Neurology	39	0.4	10,683	99.6	10,722	100
Symptoms	65	2.7	2360	97.3	2425	100
Opiates	2	0.6	357	99.4	359	100
Pregnancy	411	10.0	3681	90.0	4092	100
Total	10,235	0.2	4,255,002	99.8	4,265,237	100

Table 6. Primary care (family doctor's) treatment invoices (except pregnancy monitoring) according to HIV testing in case of HIV indicator conditions* a by gender, age group and region, Estonia, 2018*.

	Treatment invoices with indicator conditions*			Invoices without indicator conditions			Total		
	N**	n***	%	N	n	%	N	n	%
Total	**54,603**	**464**	**4.8**	**4,206,317**	**9360**	**0.2**	**4,260,920**	**9824**	**0.2**
Gender (in 0 cases gender unknown)									
Male	22,449	230	1.0	1,700,345	4676	0.3	1,722,794	4906	0.3
Female	32,154	234	0.7	2,506,071	4684	0.2	2,538,225	4918	0.2
Age group (years) (in 154 cases age unknown)									
0-15	5964	10	0.2	748,557	126	< 0.1	754,721	136	< 0.1
16-49	22,088	313	1.4	1,157,240	7003	0.6	1,179,328	7316	0.6
≥ 50	26,551	141	0.5	2,300,391	2231	0.1	2,326,942	2372	0.1
Region (in 9255 cases region unknown)									
Harjumaa	24,270	301	1.2	1,781,357	6054	0.3	1,805,627	6355	0.4
Ida-Virumaa	5298	68	1.3	452,902	1413	0.3	458,210	1481	0.3
Tartumaa	6807	26	0.4	515,129	506	0.1	521,936	532	0.1
Rest of Estonia	18,105	69	0.4	1,447,996	1350	0.1	1,466,101	1419	0.1
Other****	3	0	0	39	1	2.6	42	1	2.4

*Indicator condition and diseases, except pregnancy monitoring, which have been left out
**All invoices
***Invoices with HIV-test
****Foreign, place of residence unknown

Table 7. Specialist doctors' treatment invoices (except pregnancy monitoring) according to HIV testing in case of HIV indicator conditions* by gender, age group and region, Estonia, 2018.

	Invoices with indicator conditions*			**Invoices without indicator conditions**			**Total**		
	N**	**n*****	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Total	**99,457**	**4451**	**4.5**	**3,568,444**	**52,532**	**1.5**	**3,667,901**	**56,983**	**1.6**
Gender (in 102 cases gender unknown)									
Male	36,906	1837	4.9	1,389,644	17,406	1.3	1,426,550	19,243	1.3
Female	62,549	2612	4.2	2,178,700	35,118	1.6	2,241,249	37,730	1.7
Age group (years) (in 954 cases age unknown)									
0–15	3659	42	1.2	755,875	568	0.1	759,534	610	0.1
16–49	45,316	2874	6.3	1,136,468	31,644	2.3	1,181,784	34,518	2.9
≥ 50	50,465	1529	3.0	1,675,164	20,270	1.2	1,725,629	21,799	1.3
Region (in 6427 cases region unknown)									
Harjumaa	43,211	2034	4.7	1,558,610	25,323	1.6	1,601,821	27,357	1.7
Ida-Virumaa	12,177	635	5.2	401,053	8060	2.0	413,230	8695	2.1
Tartumaa	10,922	544	5.0	436,316	6186	1.4	447,238	6730	1.5
Rest of Estonia	32,903	1210	3.7	1,163,663	12,662	1.1	1,196,566	13,872	1.2
Other*****	50	10	20.0	2569	140	5.5	2619	150	5.7

*Indicator conditions and illnesses, except pregnancy monitoring

**All invoices

***Invoices with HIV-test

**** Foreign, place of residence unknown

Table 8. Treatment invoices with indicator conditions by specialty, which have HIV testing percentage, Estonia, 2018 (%).

Specialty	None	Tumors	Infectious diseases	STI	Pneumonia	Skin diseases	Nephrology	Neurology	Symptoms	Opiates	Pregnancy	Hematopoietic diseases	Total
Otorhinolaryngologist	0.2	0	0	-	6.7	0	-	0	0	-	0	-	0.2
Surgery	1.3	9.8	8.4	8.7	8.5	2.5	0	0.5	2.4	0	1.9	-	9
Gynecology	5.6	9	2.4	10.4	0	0	-	0	9.1	50.0	19.1	-	9.6
Tuberculosis	1.2	11.8	14.9	-	10.4	0	-	-	0	-	-	-	3.6
Pulmonology	0.6	3.2	3.3	0	9.2	0	-	0	18.2	-	-	-	0.9
Dermatovenerologists	2.3	0	2.5	15.2	0	2.3	-	-	-	-	34.7	-	2.4
Pediatrics	0.1	12.5	3.0	0	0.4	0	0	0	2.2	-	0.3	0	0.1
Psychiatry	0.6	0	0	14.3	0	0	-	0	-	0.3	-	-	0.6
Infectious diseases	10.4	14.3	17.4	24.3	19.9	16.7	-	-	31.8	0	22.2	-	11.4
Internal diseases	2.3	2.8	8.3	4.9	5.7	3.6	0	1.4	6.6	11.3	0.1	-	2.3
Oncology	0.8	2.2	6.5	0	2.5	0	-	0	0	-	0	-	0.9
Other	0	0	3.2	0	0.2	3.5	-	0	0	0	0	-	0

- No treatment invoices without indicator condition

Table 9. All people who received health care services based on HIV testing by gender, age group and region, Estonia, 2018.

	HIV-tested		HIV-untested		Total	
	n	**%**	**n**	**%**	**n**	**%**
Total	**79,795**	**6.9**	**1,068,432**	**93.1**	**1,148,227**	**100**
Gender (in 93 cases gender unknown)						
Male	21,742	4.3	486,816	95.7	508,558	100
Female	58,042	9.1	581,534	90.9	639,576	100
Age group (years) (in 759 cases age unknown)						
0–15	727	0.3	216,408	99.7	217,135	100
16–49	57,003	12.6	396,036	87.4	453,039	100
≥ 50	22,008	4.6	455,286	95.4	477,294	100
Region (in 4773 cases regioon unknown)						
Harjumaa	39,821	7.9	464,218	92.1	504,039	100
Ida-Virumaa	10,572	8.8	109,200	91.2	119,772	100
Tartumaa	9353	7	124,290	93	133,643	100
Rest of Estonia	19,713	5.1	364,194	94.9	383,907	100
Other*	152	7.3	1941	92.7	2093	100

*Foreign, place of recidence unknown

Table 10. All people who received health care services according to HIV-testing by gender* in age groups and regions, Estonia, 2018.

	Male			Female			Total		
	N**	**n*****	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Total	**508,558**	**21,742**	**4.3**	**639,576**	**58,042**	**9.1**	**1,148,227**	**79,795**	**100**
Age group (years)									
0–15	111,429	305	0.3	105,706	422	0.4	217,135	727	0.3
16–49	211,368	13,039	6.2	241,671	43,964	18.2	453,039	57,003	12.6
≥ 50	185,304	8360	4.5	291,989	13,648	4.7	477,293	22,008	4.6
Region									
Harjumaa	218,216	10,552	4.8	285,823	29,269	10.2	504,039	39,821	7.9
Ida-Virumaa	51,769	3241	6.3	68,003	7331	10.8	119,772	10,572	8.8
Tartumaa	59,257	2361	3.9	74,386	6992	9.4	133,643	9353	7.0
Rest of Estonia	175,156	5398	3.1	208,750	14,315	6.9	383,906	19,713	5.1
Other****	1362	101	7.4	639	40	6.3	2001	141	7.0

*In 93 cases gender unknown (left out)
**Number of persons receiving health care services
***Number of persons tested for HIV at least once
****Foreign, place of residence unknown

Table 11. All people who received health care services according to HIV-testing in regions by age group, Estonia, 2018.

Age group*	0–15			16–49			≥ 50			Total		
	N**	n***	%	N*	n	%	N*	n	%	N*	n	%
Harjumaa	103,439	328	0.3	211,193	30,600	14.5	189,405	8893	4.7	504,037	39,821	7.9
Ida-Virumaa	18,886	213	0.1	40,613	6408	15.8	60,272	3951	6.6	119,771	10,572	8.8
Tartumaa	28,745	60	0.2	54,734	6427	11.7	50,164	2866	5.7	133,643	9353	7.0
Rest of Estonia	65,752	124	0.2	142,543	13,343	9.4	175,609	6246	3.6	383,904	19,713	5.1
Other****	163	2	1.2	851	79	9.3	327	14	4.3	1341	95	7.1
Total	216,985	727	0.3	449,934	56,857	12.6	475,777	21970	4.6	1,142,696	79,554	7.0

*In 4014 cases region unknown (left out)

** Number of persons receiving health care services

***Number of persons tested for HIV at least once

****Foreign, place of residence unknown

Table 12. People who received health care services in primary care (by family doctor's) based on HIV testing by gender, age group and region, Estonia, 2018.12.
People who received health care services in primary care (by family doctor's) based on HIV testing by gender, age group and region, Estonia, 2018.

	HIV-tested		HIV-untested		Total	
	n	%	n	%	N	%
Total	**10,000**	**1.0**	**1,027,283**	**99.0**	**1,037,283**	**100**
Gender						
Male	4808	1.1	451,042	98.9	455,850	100
Female	5192	0.9	576,241	99.1	581,433	100
Age group (years) (in 9 cases age unknown)						
0–15	136	< 0.1	188,020	99.9	188,156	100
16-49	7511	1.9	386,581	98.1	394,092	100
≥ 50	2353	0.5	452,673	99.5	455,026	100
Region						
Harjumaa	6541	1.4	446,815	98.6	453,356	100
Ida-Virumaa	1476	1.4	108,154	98.6	109,630	100
Tartumaa	541	0.5	120,410	99.5	120,951	100
Rest of Estonia	1413	0.4	348,037	99.6	349,450	100
Other*	29	0.7	3867	99.3	3896	100

*Foreign, place of residence unknown

Table 13. People who received health care services in primary care according to HIV-testing by gender in age groups and regions, Estonia, 2018.

	Male			Female			Total		
	N*	**n****	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Total	**1,426,553**	**36,906**	**5.6**	**2,394,613**	**62,549**	**2.6**	**3,821,166**	**99,455**	**100**
Age group (years)									
0–15	96,755	70	< 0.1	91,401	66	< 0.1	188,156	136	0.1
16-49	183,136	3647	1.9	210,956	3864	1.8	394,092	7511	1.9
≥ 50	175,955	1091	0.6	279,091	1262	0.5	455,046	2353	0.5
Region									
Harjumaa	195,251	2996	1.5	258,105	3545	1.4	453,356	6541	1.4
Ida-Virumaa	46,744	692	1.5	62,886	784	1.3	109,630	1476	1.3
Tartumaa	53,237	282	0.5	67,714	259	0.4	120,951	541	0.4
Rest of Estonia	158,472	815	0.5	190,978	598	0.3	349,450	1413	0.4
Other***	2146	23	1.1	1750	6	0.3	3896	29	0.7

* Number of persons receiving health care services

**Number of persons tested for HIV at least once

***Foreign, place of residence unknown

Table 14. People who received health care services in primary care according to HIV-testing in regions by age group, Estonia, 2018.

Age group/region*	0–15			16–49			≥ 50			Total		
	N**	n***	%	N	n	%	N	n	%	N	n	%
Harjumaa	89,482	79	< 0.1	184,098	5162	2.8	179,773	1300	0.7	453,353	6541	1.4
Ida-Virumaa	16,813	35	0.2	35,177	874	2.5	57,639	567	0.9	109,629	1476	1.3
Tartumaa	24,923	5	< 0.1	48,055	413	0.9	47,973	123	0.3	120,951	541	0.4
Rest of Estonia	56,801	17	< 0.1	124,403	1039	0.8	168,243	357	0.2	349,447	1413	0.4
Other****	137	0	0	2359	23	0.9	1398	6	0.4	3894	29	0.7
Total	188,156	136	0.1	394,092	7511	1.9	455,026	2353	0.5	1,037,274	10000	1.0

* In 9 cases age unknown (left out)

**Number of persons receiving health care services

*** Number of people tested for HIV at least once

****Foreign, place of residence unknown

Table 15. People who received health care services by specialists, based on HIV testing by gender, age group and region, Estonia, 2018.

	HIV-tested		HIV-untested		Total	
	n	**%**	**n**	**%**	**n**	**%**
Total	**70,991**	**8.1**	**804,764**	**91.9**	**875,755**	**100**
Gender (in 93 cases gender unknown)						
Male	17,307	4.8	342,843	95.2	360,150	100
Female	53,673	10.4	461,839	89.6	515,512	100
Age group (years) (in 757 cases age unknown)						
0–15	596	0.3	185,399	99.7	185,995	100
16–49	50,522	15.2	281,554	84.8	332,076	100
≥ 50	19,816	5.6	337,111	94.4	356,927	100
Region (in 0 cases region unknown)						
Harjumaa	34,029	9.0	345,337	91.0	379,366	100
Ida-Virumaa	9296	9.7	86,850	90.3	96,146	100
Tartumaa	8889	8.5	95,724	91.5	104,613	100
Rest of Estonia	18,455	6.3	272,882	93.7	291,337	100
Other*	322	7.5	3971	92.5	4293	100

*Foreign, place of residence unknown

Table 16. People who received health care services by specialists according to HIV-testing by gender in age groups and regions, Estonia, 2018.

	Male			Female			Total		
	N*	**n****	**%**	**N**	**n**	**%**	**N**	**n**	**%**
Total	359,695	17,269	4.8	515,302	53,665	10.4	874,997	70,934	8.1
Age group (years)									
0–15	95,645	236	0.3	90,350	360	0.4	185,995	596	0.3
16–49	136,103	9705	7.1	195,973	40,817	20.8	332,076	50,522	15.2
≥ 50	127,947	7328	5.7	228,979	12,488	5.5	356,926	19,816	5.6
Region									
Harjumaa	151,567	7751	5.1	227,799	26,278	11.5	379,366	34,029	8.9
Ida-Virumaa	39,230	2622	6.7	56,916	6674	11.7	96,146	9296	9.7
Tartumaa	43,474	2108	4.9	61,139	6781	11.1	104,613	8889	8.5
Rest of Estonia	123,133	4650	3.8	168,203	13,805	8.2	291,336	18,455	6.3
Other***	2746	176	6.4	1455	135	9.3	4201	311	7.4

* Number of persons receiving health care services

**Number of persons tested for HIV at least once

***Foreign, place of residence unknown

Table 17. People who received health care services by specialists according to HIV-testing in regions by age group, Estonia, 2018.

Age group*	0–15			16–49			≥ 50			Total		
	N**	n***	%	N	n	%	N	n	%	N	n	%
Harjumaa	87,970	249	0.3	151,157	26,113	17.3	140,239	7667	5.5	379,366	34,029	8.9
Ida-Virumaa	16,572	181	1.1	32,141	5685	17.7	47,433	3430	7.2	96,146	9296	9.7
Tartumaa	25,324	55	0.2	41,359	6080	14.7	37,930	2754	7.3	104,613	8889	8.5
Rest of Estonia	55,916	109	0.2	105,025	12,432	11.8	130,396	5914	4.5	291,337	18,455	6.3
Other****	213	2	0.9	2394	212	8.9	929	51	5.5	3536	265	7.5
Total	185,995	596	0.3	332,076	50,522	15.2	356,927	19,816	5.6	874,998	70,934	8.1

*Unknown age group left out
**Number of persons receiving health care services
*** Number of persons tested for HIV at least once
****Foreign, place of residence unknown

Table 18. Positivity rate of HIV-tests by gender and age in different regions, Estonia, 2018.

Gender/age group	Tallinn and Harjumaa			Ida-Virumaa			Rest of Estonia			Total		
	Number of tests, n*	Number of new HIV cases, n**	Tests' positivity rate, %	Number of tests, n	Number of new HIV cases, n	Tests' positivity rate, %	Number of tests, n	Number of new HIV cases, n	Tests' positivity rate, %	Number of tests, n	Number of new HIV cases, n	Tests' positivity rate, %
Male												
0–15	148	0	0	89	0	0	76	0	0	313	0	0
16–49	7911	52	0.7	2070	24	1.2	4351	19	0.4	14,332	95	0.7
≥ 50	3626	12	0.3	1499	5	0.3	4149	2	0.05	9274	19	0.2
Female												
0–15	195	0	0	143	0	0	123	0	0	461	0	0
16–49	29,995	24	0.08	5961	20	0.3	20,088	5	0.02	56,044	49	0.09
≥ 50	6034	4	0.07	2887	3	0.1	5912	1	0.02	14,833	8	0.05
Total	47,909	92	0.2	12,649	52	0.4	34,699	27	0.08	95,257	171	0.2

*Patient without age, gender, county, or foreign place of residence were not added. Therefore, there are 95,257 tests in total (425 tests less than the total)

** Blood donors (n = 2) and detainees (n = 17) were left out, as the tests performed on them are not reflected in the EHIF's treatment invoices database. New cases of HIV that were initially identified anonymously are covered, because they will be notified by the health care institutions to the Health Board, but no treatment invoices are reported. Thus the actual number of anonymously diagnosed is not known.

Table 19. HIV testing among 15–49 years old in Harjumaa and Ida-Virumaa, Estonia, 2018.

	Harjumaa	Ida-Virumaa
Men		
All people who received health care services (N)	95,952	20,525
HIV tested persons (n)	7112	1870
Percentage of persons tested (%)	7.4	9.1
Women		
All people who received health care services (N)	120,099	21,327
HIV tested persons (n)	23,528	4618
Percentage of persons tested (%)	19.6	21.7

Table 20.All treatment invoices according to HIV testing in case of HIV indicator conditions by gender among 15–49 years old people, Estonia, 2018.

Diagnosis	**Male**			**Female**			**Total**		
	N*	n**	**%**	**N***	**n****	**%**	**N**	**n**	**%**
Herpes zoster	361	30	8.3	589	29	4.9	950	59	6.2
STI	689	143	20.8	3253	388	11.9	3942	531	13.5
Mononucleosis	243	65	26.8	312	63	20.2	555	128	23.1

*All invoices
*Of these, invoices with HIV tests