A Clinical Decision Support Tool for the Management of Sexually Transmitted Infections Among Women

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Leighanna D. Lawson is a registered nurse.

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Abstract

Sexually transmitted infections (STIs) are a variety of infections caused by pathogens acquired and transmitted through sexual activity (World Health Organization [WHO], 2021). STIs are associated with an increase in chronic pelvic pain, pelvic inflammatory disease (PID), infertility, and pregnancy complications (Centers for Disease Control and Prevention [CDC], 2021e). A clinical decision support (CDS) tool provides assistance to healthcare providers to use a logical, step-by-step method in patient management by incorporating different reminders or guidelines into practice. The purpose of this project is to assist healthcare providers to manage positive STI results per the CDC guidelines via a CDS tool. A CDS tool for positive STI management was implemented as a system wide practice change. A retrospective chart audit revealed the CDS tool was used 49% of the time. When the CDS tool was utilized, documented partner treatment, screening for additional STIs, documented follow-up, condoms offered, provider discussion of screening of other STIs, and treatment of the STI all increased. This project displays that utilization of a CDS tool can improve the management of positive STIs in a women's healthcare setting.

Keywords: clinical decision support tool, sexually transmitted infections, STIs, primary care clinic

A Clinical Decision Support Tool for the Management of Sexually Transmitted Infections Among Women

There are numerous diseases acquired throughout the United States (U.S.) each year, in which the spread of many of these can be decreased with proper preventable measures. Sexually transmitted infections (STIs) consist of a variety of clinical complaints and infections that are acquired and transmitted through sexual activity (Centers for Disease Control and Prevention [CDC], 2021a). STIs are caused by 30 different bacteria, viruses, and parasites that give rise to chlamydia, gonorrhea, syphilis, trichomonas, hepatitis B, hepatitis C, herpes simplex virus (HSV), human papillomavirus (HPV), and human immunodeficiency virus (HIV) (WHO, 2021).

Healthcare providers have a duty to ensure that they are properly treating their patients based on evidence-based practice (EBP). STIs are being diagnosed in various health care settings. A principle of STI care is timely management of infections. There are many national initiatives addressing the management of positive STI results. The CDC released an evidence-based prevention, diagnostic, and treatment guideline to provide a source for clinical guidance (CDC, 2021a). Proper management of STIs includes effective diagnosis, treatment, counseling, and follow-up of infected persons and their sex partners (CDC, 2021a). Understanding the treatment and follow-up to positive STI results can help lead to an overall decrease in STI rates, a decrease in costs associated with STIs, increase partner treatment therapy, and an increase in patient and provider education.

Background and Significance

Problem Statement

Healthcare providers play a critical role in managing STIs and help prevent the spread of infection. Negative health outcomes for women associated with positive STIs include increased

risk of HIV infection, chronic pelvic pain, pelvic inflammatory disease (PID), infertility, pregnancy and newborn complications, and infant death (CDC, 2021e). Chlamydia and gonorrhea are preventable causes PID and infertility. If chlamydia is left untreated, 10-15% of women will develop PID (CDC, 2021d).

Screening for STIs.

There any many national initiatives for healthcare providers that provide guidance of STI management. The U.S. Preventive Services Task Force (USPTF) and the CDC provide screening recommendations for STIs. For chlamydia and gonorrhea, it is recommended for routine screening in all sexually active women 24 years or younger and in women 25 years or older who are at an increased risk for infection (CDC, 2021a; USPTF, 2021). Syphilis screening should occur in those at increased risk including men who have sex with men, persons who are positive for HIV, a history of incarceration, partake in sex work, and males younger than 29 years old (CDC, 2021a; USPSTF, 2016). One major strategy in prevention and control of STIs is identification of asymptomatically infection persons and persons with symptoms associated with STIs (CDC, 2021a).

Screening for other STIs.

After a positive STI result, the first line of action is treating the STI as indicated by the CDC's *STI Treatment Guidelines, 2021* (CDC, 2021a). Another management consideration of a positive STI result is to screen for additional STIs. For individuals who receive a diagnosis of chlamydia, they should be tested for HIV, gonorrhea, and syphilis (CDC, 2021a). Similarly, when a person tests positive for gonorrhea they should be tested for chlamydia, syphilis, and HIV (2021a). Primary and secondary syphilis diagnoses should be followed up with testing for HIV (CDC, 2021a).

Expedited partner therapy.

Another management guideline includes treating sexual partners of those that have been exposed following a positive STI diagnosis of an individual. Expedited partner therapy (EPT) gives healthcare providers the ability to prescribe medications to patient's partners without examining them first (American College of Obstetricians and Gynecologists [ACOG], 2018). EPT should be offered to all sexual partners within the last two months who are unable to seek medical services (ACOG, 2018). EPT is permissible in 46 states including Arizona (CDC, 2021f). Written education materials should be provided when providing EPT and include potential therapy-related allergies and adverse effects (ACOG, 2018; CDC 2021a). Sexual partners should be advised to seek medical evaluation to discuss screening for other STIs. Patients and partners should be informed to abstain from sexual intercourse for seven days after completion of medication treatment (ACOG, 2018). Persons exposed to primary, secondary, or early latent syphilis should be evaluated clinically and serologically and treated according to CDC recommendations (CDC, 2021a). High rates of STIs can be attributed to reinfection from partners. Therefore, healthcare providers ability to use EPT is beneficial.

Other management considerations.

Follow-up testing for STIs is the action of testing for the same STI that was positive to ensure eradication or cure after treatment. After a positive chlamydia or gonorrhea diagnosis, retesting is recommended at three months post treatment while an individual with a positive syphilis diagnosis is recommended to receive retesting at six months (CDC, 2021a). Additional STI management would include offering behavioral counseling interventions to those individuals that are at an increased risk for STIs, have been diagnosed with an STI within the past year, do not use condoms, and those who have multiple sex partners (USPSTF, 2020). Best practice

would consist of implementing behavioral counseling or referring patients to counseling. Behavioral counseling includes in person counseling, videos, websites, written materials, telephone support, and text message support (USPSTF, 2020). Future implications consist of increasing on-site and point-of-care behavioral counseling services within a variety of settings and patient populations to ensure compliance from patients and increase STI health outcomes (Barrow, 2020).

Chlamydia

Chlamydia infections are the most frequently reported bacterial infectious disease in the U.S. and prevalence is highest among persons aged less than 24 years old (CDC, 2021a). Serious complications for women from chlamydia include PID, ectopic pregnancy, and infertility (CDC, 2021a). Treating persons with chlamydia prevents adverse reproductive health outcomes and continued sexual transmission. Initiating EPT remains low. Data suggests that only 50% of healthcare providers have ever used EPT and up to 27% report always using EPT (Barrow, 2020).

Gonorrhea

Gonorrhea is the second most commonly reported bacterial communicable disease (CDC, 2021a). Among women, gonorrhea is commonly asymptomatic (CDC, 2021a). Data shows that while gonorrhea is routinely treated per the CDC recommendations, only 31% of the time follow-up care was accomplished within 3 months of initial testing with a reinfection rate of 56% (Boyajian et al., 2016). In this same study, 60% of healthcare providers did not document partner therapy (Boyajian et al., 2016).

Syphilis

Syphilis is a systemic disease divided into stages on the basis of clinic findings, which guides treatment and follow-up (CDC, 2021a). Data shows that 88% of healthcare providers and medical students have no experience or feel they are inexperienced with diagnosing and treating syphilis (Bonnewell et el., 2020).

Epidemiological Data

National rates of STIs continue to be on the rise and the state of Arizona is increasingly contributing to these levels. In 2019 there were more than 2.5 million cases of chlamydia, gonorrhea, and syphilis reported in the U.S. leading to an all-time high for the sixth consecutive year (CDC, 2021c). In 2019 the state of Arizona surpassed the national rates for chlamydia, gonorrhea, and syphilis (CDC, 2021e). National rates for chlamydia were 552.8 per 100,000 population while Arizona was at 600.4 per 100,000 (CDC, 2021e). National rates for gonorrhea were 188.4 per 100,000 population and the state of Arizona reported 285.1 per 100,000 (CDC, 2021e). U.S. syphilis rates were 39.7 per 100,000 population and Arizona had a rate of 58.6 per 100,000 (CDC, 2021e). High rates of STIs can be attributed to a reduction in screening, treatment, prevention, and partner services (CDC, 2021c). According to the CDC, increasing rates of STIs can be linked to management or a lack thereof (CDC, 2021c).

Purpose and Rationale

Healthcare providers ability to incorporate national guidelines for the management of positive STIs can lead to a decrease in STI rates, a decrease in associated medical costs, and an increase in partner treatment leading to a decrease in community transmission rates. The purpose of this literature review is to establish an intervention that can be implemented by healthcare providers to ensure that they are following current national guidelines for the management of positive STI results.

Internal Evidence

A federally qualified healthcare center (FQHC) within the Southwestern U.S. provides women's healthcare that includes STI testing as part of routine care. In 2020, the women's health department screened a total of 15,921 patients for chlamydia and gonorrhea in which 846 results were positive. Syphilis was screened in 7,642 patients and 160 results were positive. During a peer-to-peer review, inconsistency in the management of positive STI results was noted. Inquiring about proper STI management has led to the PICO question, "In women who test positive for a sexually transmitted infection, how does a clinical decision support tool compared to no clinical decision support tool assist healthcare providers to manage positive sexually transmitted infections?"

Evidence Synthesis

Search Strategy

PubMed.

The PubMed database was utilized in part of an exhaustive literature search. Keywords used were *decision support systems, primary care clinic, primary care, clinical decision support systems, clinical decision support tool,* and *primary health care*. The first search was done using a previously retrieved journal article title of "*Development and implementation of a clinical decision support tool for treatment of uncomplicated urinary tract infections in a family medicine resident clinic*" which yielded one result. The MESH term of *decision support system*s, *clinical* yielded 6,072 results. The third search within this database was *decision support systems* AND *primary care clinic,* this yielded 2,636 results. The database search of *decision support systems* AND *primary care clinic* with a limitation on publication year from 2015-2021 yielded 1,356 results. *Clinical decision support systems* AND *primary care* yielded 2,520 results.

Clinical decision support systems AND *primary care* with the publication year limitation of 2015-2021 yielded 1,300 results. Using Boolean phrases yielded better results, "*clinical decision support tool*" AND "*primary care clinic*" OR *"primary care"* OR "*primary health care*" had 73 results. "*Clinical decision support tool*" AND "*primary care clinic*" OR *"primary health care"* with the limitations on publication year of 2015-2021 yielded 57 results. Inclusion criteria included English written articles and those that were published within the years of 2015-2021. No population age group was excluded and exclusions were not made on the type of illness the decision support tool was attempting to improve.

CINAHL.

Literature searches were done within the Cumulative Index of Nursing and Allied Health (CINAHL) database. The first search of "*decision support system*" AND "*primary care*" OR "*primary health care*" OR "*primary healthcare*", yielded 478 results. "*Decision support system*" AND "*primary care clinics*" OR "*primary health care*" OR "*primary healthcare*" with the limiters of publication date between 2015-2021 yielded 237 results. The search within the database of "*clinical decision support systems*" OR "*cdss*" AND "*primary care clinics*" OR "*primary health care*" OR "*primary healthcare*" with publication years of 2015-2021 produced 206 results. "*Clinical decision support tool*" AND "*primary care*" OR "*primary health care*" OR "*primary healthcare*" yielded 76 results. "*Clinical decision support tool*" AND "*primary care*" OR *"primary health care"* OR "*primary healthca*re" with the limiter of publication year of 2015-2021 had 58 results. Inclusion criteria for articles retrieved in CINAHL was publication years of 2015-2021. No population age group was excluded and exclusions were not made on the type of illness the decision support tool was attempting to improve.

Cochrane library.

Literature searches were also obtained within the Cochrane library. The first search of *"clinical decision tool"* posed 23 results. *"Primary care clinic"* yielded 510 results. "*Clinical decision tool"* AND "*primary care clinic"* achieved 0 results. The next search that was done included, "*clinical decision support tool"* AND "*primary care"* that yielded 28 results. *"Decision support system"* AND "*primary care clinic"* had 12 results. The final search of "*clinical decision support system"* AND "*primary care"* yielded 97 results. Inclusion criteria for the articles retrieved from the Cochrane database were within the years of 2015-2021. No population age group was excluded and exclusions were not made on the type of illness the decision support tool was attempting to improve. One article was retrieved from Cochrane library as there were not ample amounts of research articles that were geared towards managing clinical illnesses with a clinical decision support (CDS) tool.

Grey literature.

Grey literature was obtained from the CDC and USPSTF. STI treatment guidelines were examined from the CDC's *STI Treatment Guidelines, 2021*, these guidelines are evidence based for the management of STIs (CDC, 2021a). There are many national initiatives currently in place and aimed at prevention and management measurements for STIs. The U.S. Department of Health and Human Services (HHS), has a *Sexually Transmitted Infections National Strategic Plan* (2019). HHS's goal is to prevent new STIs, reduce adverse outcomes; increase research of STIs, reduce health disparities; and increase efforts to address the STI epidemic (HHS, 2019). Healthy People 2030 is a federal government prevention agenda for building a healthier nation, with the goal of increasing STI screening and prevention measures in women (HHS, 2020).

Critical Appraisal

Ten studies were chosen for critical appraisal from the exhaustive literature search. Multiple quantitative studies were examined to interpret similarities and differences to better understand how to correlate a design in order to eliminate gaps seen with properly treating different STIs seen in women (see Appendices A, Tables A1 and A2). Research that was studied ranged from the years between 2017 and 2020. Eight out of the ten studies were performed in the U.S., whereas the other two studies were done within the United Kingdom or Canada. Study participants ranged from 27 to 22,279. All but one research study was done within a primary care setting; the outlier was performed within an emergency setting. Most of the studies used an innovation theory to develop a CDS tool to assist healthcare providers in screening for and managing their patient's diagnoses. Development of a CDS tool was seen as a strength within all of the studies as there was statistical data that correlated with better management of patients. Bias's seen within the studies were either none, publication bias, or selection bias. Publication bias came from pharmaceutical companies that were funding the research projects and in turn the increased use of a medication with the assistance of the CDS tool. Selection bias was due to researchers picking and choosing exactly which healthcare providers they would like to target to use the CDS tool, which does not allow for random selection and could pose a harder ability to replicate study results. Common weaknesses seen between all studies was the use of the CDS tool was limited as it was only used within one health care system. However, the application of a CDS tool could prove beneficial within other health care systems and results would likely be replicated.

Synthesis of Evidence

The use of a CDS tool is shown to improve management of patients. CDS tools act as alerts or reminders and can focus on clinical guidelines, condition-specific order sets,

documentation templates, or diagnostic support (Arbogast et al., 2017; Connelly & Bickel, 2020; Cox et al., 2020; Karas et al., 2018; Kessler et al, 2017; Kharbanda et al., 2018; Miller et al., 2019; Palen et al, 2019; Pell et al., 2020; Siaki et al., 2021). According to the evidence seen within the literature there was a positive increase in healthcare providers ability to better treat their patients. The assistance of a CDS tool allows healthcare providers to use a logical, step-by-step tool in patient management. Based on some diagnoses or treatment plans, there may be multiple steps that need to be taken by the healthcare provider to ensure evidence-based care. When healthcare providers receive a positive STI test for patients, there are multiple EBP actions. The ability of healthcare providers to care properly for their patients that have STIs can help ensure that the patient is treated properly and have a decreased chance of returning with concern of reinfection or a new STI. Based on the evidence, a CDS tool can help ensure proper management of positive STIs.

Theoretical Framework & Implementation Framework

Theory Application

According to Ludwig von Bertalanffy his identification of the General System Theory is an understanding of how systems interact with one another in which new properties emerge (1968). His theory can directly relate to the evidence that is seen within the research literature (see Appendix B, Figure B1). The theory envelopes a system of analysis, design, development, and implementation. This theory directly relates to the literature as there was a need for standardization of the management of positive STI results; this would be the analysis portion of the General System Theory. The identification of a clinical problem and the desire to adapt a systems change is the first step within this theory, and the first step needed in order to standardize care. The design of the electronic CDS tool came from the data that was expressed

within the internal evidence. After the CDS tool design, development of the tool for positive STI results was created. After developing the CDS tool, the instrument was incorporated into an electronic health record (EHR) as a system wide practice change.

Innovation Model

The quality improvement model used to guide this project was developed by Dr. Walter Shewhart in 1993. This improvement cycle design incorporates the concepts of plan, do, study, and act (PDSA) (Shewhart, 1993). The PDSA model is a circular model in which each stage feeds off the past stage in order to obtain one goal of improvement (see Appendix B, Figure B2). The "Plan" step within the PDSA model can be attributed with an overall goal of the standardization of positive STI management, design of the CDS tool, creation of the chart audit tool, and healthcare provider education on the CDS tool. Within the "Do" step of the PDSA model, a retrospective chart audit obtained pre and post CDS tool implementation occurred. The "Study" portion of this model is illustrated with healthcare provider usage of CDS tool and studying data analysis for any gaps in CDS tool usage amongst healthcare providers. "Act" can be implemented by making CDS tool changes based on data analysis and providing healthcare provider education based on gaps of care.

Methods

Ethical Considerations

Four elements of ethics that one should be mindful of is autonomy, justice, beneficence, and non-maleficence. Autonomy is a requirement in which an individual needs to have the full authority to make health care decisions on their own, based on the principle that they fully understand all associated risks and benefits (*Medical Ethics 101,* n.d.). The participants within this project are healthcare providers at the project site. This project is in compliance with a

change of practice and all healthcare providers have been educated on this change of practice. Justice is the idea that all benefits and downfalls of any experimental treatment must be distributed in a way that is equal to all participants (*Medical Ethics 101,* n.d.). The project adhered to this principle by ensuring that all participants within the project were given equal access to the CDS tool. Beneficence is the defined as healthcare providers taking ownership of their skills and knowledge for the benefit and good of the patient (*Medical Ethics 101*, n.d.). The project accomplished this as this project enhances healthcare providers' knowledge and skills on properly treating women who have a positive STI result. Non-maleficence is a do no harm principle in which healthcare providers need to ensure that all procedures are not harmful to the patient or others in society (*Medical Ethics 101,* n.d.). The project adhered to this by ensuring there was no harm to subjects. There were no risks with patient information as all data was de-identified when recorded on the chart audit tool. Participants' rights and risks are ensured to be protected by means of total transparency and proper confidentiality. IRB expedited approval was obtained by Arizona State University (ASU).

Setting and Stakeholders

The setting in which this project took place was a FQHC within the Southwestern U.S. The project site offers a wide variety of services including pediatrics, women's health/pregnancy, internal/family medicine, pharmacy, dental, and women, infants, and children (WIC) services. The project site is accredited by The Joint Commission and are deemed a facility under the Health Resources and Services Administration's Federal Tort Claims Act (FTCA). Employees from this organization range from nurse practitioners, physicians, physician assistants, registered dieticians, and psychiatrists. The goal of this organization is to work with the communities it

serves to sustain and improve health by providing affordable primary care. Stakeholders include the corporate team, healthcare providers, and the patients seen within this project site.

Change of Practice

Prior to the project, there was no standardized process for management of positive STI results. A system wide practice change occurred on 06/15/2021 to bring the project site in alignment with the current national clinical practice guidelines from the CDC via a CDS tool. Development of the CDS tool is based on the CDC's *STI Treatment Guidelines, 2021* (CDC, 2021a). The tool received face validity and was imported to the project sites' EHR (see Appendix C, Figure C1).

After the CDS tool was implemented, ASU IRB approval was granted on 10/15/2021 for a secondary data analysis. The retrospective chart audit focused on utilization of the CDS tool and management of positive STI guidelines per the CDC guidelines. A pre-intervention chart audit was completed on patient charts with a positive chlamydia, gonorrhea, and/or syphilis result from September 1, 2020 to December 31,2020. A post-intervention chart audit was completed on patient charts with a positive chlamydia, gonorrhea, and/or syphilis result between September 1, 2021 to December 31, 2021.These charts were reviewed using a self-developed chart audit tool in order to examine how many components of national STI guidelines were adhered to (see Appendix C, Figure C2).

Participants and Recruitment

No recruitment methods were used as this intervention is a universal change of practice at the project site. No compensation was given to participants and no additional costs were needed for participation in the project. Participants included any healthcare provider (nurse practitioners and obstetrical and gynecology physicians) that practiced within the women's health department

of the project site. There were no signed consent forms as this is a system practice change. A retrospective chart audit was completed pre and post intervention. Inclusion criteria for the retrospective chart audit were: females, 18 years of age or older, receiving care in the women's health department, that had a positive chlamydia, gonorrhea, and/or syphilis test result. Exclusion criteria for the retrospective chart audit was any individual under the age of 18 years of age, anyone seen in a different department that is not women's health, or women receiving prenatal care.

Pre-Intervention Chart Review

A retrospective chart audit was performed using the chart audit tool for charts that met the inclusion criteria. The chart audit tool received face validity and contained no patient identifiers. A list of individuals that met the inclusion criteria between 09/01/2020 and 12/31/2020 was given from the project site to perform the chart audits. The list contained individuals by last name, first name, date of testing, and type of test (chlamydia, gonorrhea, and/or syphilis). This list was electronic and contained a hyperlink to that individual's health record. The chart audits were completed at the project site. The data was accessed through a password protected laptop provided by the project site containing the project sites EHR. Within the EHR, data was accessed via the information provided on the list. Components reviewed within the chart audits for recommended follow up, other STI testing, and treatment is based on CDC's *STI Treatment Guidelines, 2015* which were in place during the pre-intervention chart audit timeframe.

Post-Intervention Chart Review

A retrospective chart audit was performed using the chart audit tool for charts that met the inclusion criteria. The chart audit tool received face validity and contained no identifiers. A

list of individuals that met the inclusion criteria between 09/01/2021 and 12/31/2021 was given from the project site to perform the chart audits. The list contained individuals by last name, first name, date of testing, and type of test (chlamydia, gonorrhea, and/or syphilis). This list was electronic and contained a hyperlink to that individual's health record. The chart audits were completed at the project site. The data was accessed through a password protected laptop provided by the project site containing the project sites EHR. Within the EHR, data was then accessed via the information provided on the list. Components reviewed within the chart audits for recommended follow up, other STI testing, and treatment is based on CDC's *STI Treatment Guidelines, 2021* which were in place during the post-intervention chart audit timeframe.

Data Collection

The data collected via the chart audit tool contained the following: age, gender, race, ethnicity, type of positive STI result (chlamydia, gonorrhea, and/or syphilis), clinic location, use of the CDS tool, treatment per CDC guidelines, if partner treatment was discussed, if EPT was declined or ordered, if other STIs were screened for/discussed/ordered, if safe sex practices were discussed, if condoms were offered, if follow-up plan was documented, if follow-up testing was completed in the recommended time frame, and if the STI was reported to the Arizona Department of Health Services (ADHS) (see Appendix C, Figure C2). The de-identified data was recorded on the chart audit tool within a personal password protected laptop. All patient information was de-identified and each record was assigned a random identification number. All electronic data was stored in a secure, password protected database.

A statistics database was used to run a descriptive statistical analysis. Dissemination of data included PowerPoint presentation to the project sites, PowerPoint presentation to students

and faculty at ASU, project poster presented at ASU for faculty and students, and submission of manuscript into the ASU repository.

Results

Descriptive Data

The utilization of the CDS tool improves management of positive STIs per CDC guidelines. The CDS tool was used 49% of the time. A total of 80 charts were audited pre CDS tool implementation; whereas, a total of 88 charts were audited post CDS tool implementation.

Race, ethnicity, and age.

Homogeneity in race, ethnicity, and age was noted. Pre CDS tool White race was seen at 51% with post CDS tool for White race at 46.59%. Pre CDS tool Black race was seen at 22.5%, with post CDS tool for Black race at 17.05%. Pre CDS tool American Indian/Alaskan Native was seen at 1.25%, with post CDS tool American Indian/Alaskan Native being seen at 0%. Pre CDS tool Asian race was seen at 0%, with post CDS tool for Asian race was 1.14%. Pre CDS tool for Other race was seen at 25%, with post CDS tool for Other race at 35.23%. Pre CDS tool ethnicity for Hispanic was 67.5%, with post CDS ethnicity for Hispanic being 73.86%. Pre CDS tool ethnicity of Not Hispanic was 32.5%, with post CDS ethnicity for Not Hispanic at 26.14%. Pre CDS tool average age was 26.48 years of age, with post CDS tool average age of 26.69 (see Appendix D, Figure D1).

Treatment.

Pre CDS tool usage chlamydia was treated per CDC guidelines 96.88% of the time. Post CDS tool usage, chlamydia was treated per CDC guidelines 98.44% of the time. Pre CDS tool usage gonorrhea was treated per CDC guidelines 90% of the time. Post CDC tool usage gonorrhea was treated per CDC guidelines 100% of the time. Pre CDS tool usage, when

gonorrhea and chlamydia were both positive, treatment per CDC guidelines was followed 80% of the time. Post CDS tool usage, when gonorrhea and chlamydia were both positive, treatment per CDC guidelines was followed 100%. There was no change in data pre or post CDS tool implementation for syphilis treatment per CDC guidelines; pre and post data showed syphilis was treated per CDC guidelines 100% of the time (see Appendix D, Figure D2).

Partner treatment.

Pre CDS tool, documentation of "partner treatment" was 91% with post CDS tool showing partner treatment being documented 95.45%; however, when the CDS was used post implementation documentation of "partner treatment" increased to 100% (see Appendix D, Figure D3).

Other STI screening ordered.

Pre CDS tool showed healthcare provider documentation for "other STI screening ordered" at 56% of the time, while documentation post CDS tool showed 64.77% of the time; however, with CDS tool usage the percentage increased to 79.07% (see Appendix D, Figure D3).

Documented follow-up.

Pre CDS tool healthcare providers "documented follow-up" 80% of the time, while post CDS tool showed healthcare providers "documented follow-up" 77.27%; however, when the CDS tool was used "documented follow-up" increased to 90.70% (see Appendix D, Figure D3).

Safe sex practices.

Pre CDS tool "safe sex practices" were documented 72.5% of the time, with post CDS tool being documented 68.18% of the time; however, when the CDS tool was used percentage of provider documenting "safe sex practices" was 97.67% (see Appendix D, Figure D3).

Follow-up.

Pre CDS tool “follow-up completed but not in recommended time frame” was done 60% of the time, with post CDS tool being done 35.23% of the time. Pre CDS tool “follow-up completed in recommended time frame” was done 6.82%, with post CDS tool showing 4.55% of the time; however, with CDS tool usage, “follow-up completed in recommended time frame” increased slightly to 4.65% (see Appendix D, Figure D3).

EPT.

Pre CDS tool “EPT” was ordered 46.25% of the time, post CDS tool “EPT” was ordered 34.09% of the time; however, when CDS tool was used EPT was ordered 46.51% of the time (see Appendix D, Figure D3).

Treatment per CDC guidelines.

Pre CDS tool “treatment per CDC guidelines” was followed 95% of the time, post CDS tool was 98.86% of the time; however, with CDS tool usage “treatment per CDC guidelines” increased to 100% (see Appendix D, Figure D3).

Other STI screening discussed.

Pre CDS tool “other STI screening discussed” was documented 18.75% of the time, with post CDS tool being documented for “other STI screening discussed” 42% of the time; however, when the CDS tool was used documentation increased to 58.14% (see Appendix D, Figure D3).

Condoms offered.

Pre CDS tool “condoms offered” 1.25% of time, post CDS tool “condoms offered” 45.45% of the time; however, with CDS tool usage “condoms offered” increased to 93.02% of the time (see Appendix D, Figure D3).

Reporting to ADHS.

Pre CDS tool "reporting to ADHS" was done 67.5% of the time, post CDS tool reporting was done 62.5% of the time; with CDS tool usage "reporting to ADHS" decreasing to 58.14% (see Appendix D, Figure D3).

Impact of Project

When the CDS tool was used, an increase was seen in many areas of management of positive STIs. Post CDS tool implementation and when the CDS was utilized, partner treatment increased to 100% of the time. This is important as this is the first step in management of a positive STI. Treatment prevents adverse reproductive health complications and continued sexual transmission. When the CDS tool was utilized, other STI screenings ordered increased to 79%. This is an important management consideration as it is shown that being positive for one STI puts an individual at increased risk of having another (CDC, 2022). Other STI screenings discussed is an important educational piece to positive STI management and increased to 58% if the CDS tool was utilized. Documented follow-up increased to 90% when the CDS tool was utilized. This shows healthcare providers knowledge about the recommended guidelines and provides information about when that individual with a positive STI result should return for rescreening. Safe sex practices were documented 97% of the time when the CDS tool was utilized. Safe sex education is an important management strategy to instruct positive STI individuals on the importance of transmission. EPT slightly increased to 46.51% of the time when the CDS tool was utilized. Management of sexual partners is an important piece to reduce community spread of positive STIs. Offering condoms increased to 93% of the time when the CDS tool was utilized. Condoms offer protection against the spread and obtaining a STI.

Post CDS implementation, a decrease in follow-up in the recommended time frame was noted. For chlamydia/gonorrhea recommended follow-up is 3 months after treatment and for

syphilis 6 months after treatment. (CDC, 2021a). Chart audits revealed that too early re-testing was occurring which can lead to false positive STI results or no rescreening was completed. Healthcare providers should be encouraged to set reminders or alerts for patients that do not come back for STI follow-up testing. Pre CDS tool 32.5% of patients did not return for follow-up STI testing; post CDS tool 31.82% of patients did not return for follow-up testing. Post CDS tool only 5.68% of patients were scheduled for a follow-up appointment. It would be important to encourage all patients to get scheduled for follow-up appointment when the patient is made aware of their positive STI result.

EPT is permitted in the state of Arizona (CDC, 2021f). It would be beneficial in preventing transmission of STIs if healthcare providers provided EPT services. Chart audits revealed that providing outside resources for where sexual partners can go for treatment was seen frequently. Healthcare providers gave outside resources or did not clarify in documentation if EPT was ordered or declined pre CDS tool implementation 47.5% of the time, post CDS tool implementation 32.95% of the time. Pre CDS tool 5% of patients declined EPT, post CDS tool 30.68% of patients declined EPT.

A decrease in documented mandatory reporting to the state health department was noted. Making a standardize workflow for reporting could help increase reporting to ADHS. There is a need for standardizing how STI results are reported to ADHS at the project site.

Project Sustainability

After the completion of this project, the project site will still be able to use the CDS tool as this project has encouraged a system wide practice change. The usage of the CDS tool is encouraged and apart of the workflow for when a healthcare provider encounters a positive STI individual. Data collection shows that the usage of the CDS tool does help healthcare providers

to better manage STIs, this could be beneficial data to educate all departments at the project site of this systems change and implement the CDS tool on a larger scale.

Discussion

Closing gaps within healthcare provider management of STIs can help decrease rates of STIs and better assist healthcare providers with treatment and management options. According to the evidence reviewed, it is apparent that the use of a CDS tool can be used to help treat and manage multiple different patient diagnoses. The development of the CDS tool was created as a change of practice. It has the potential to decrease rates of STIs, decrease transmission rates, and decrease costs associated with high STI rates. A highlight of the CDS tool is proper evidence-based management of STIs, which is the goal for healthcare providers.

Strengths seen with this project is that the CDS tool aligns with current national guidelines and is applicable to a variety of patient care settings. Limitations to this project is limited CDS tool usage and the CDS tool does not address risk assessment or pre-exposure vaccination. Implications are a need for standardization of reporting to ADHS and education needed on recommended post treatment follow-up. The implementation and use of the CDS tool has made a positive impact on management of STI results; with continued and improved usage it could contribute to a decrease in rates and costs associated with high rates of STIs.

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Appendix A

Evaluation and Synthesis Tables

Table A1

Quantitative Studies Evaluation Table

Citation	**Theory/ Conceptual Framework**	**Design/Method/Purpose**	**Sample/Setting**	**Variables**	**Measurement/ Instrumentation**	**Data Analysis**	**Results/ Findings**	**Level of Evidence; Application to practice/ Generalization**
(Karas et al., 2018) Using a clinical decision support tool to increase chlamydia screening across a large primary care pediatric network Country: United States of America Funding: The authors received no financial support Bias: None stated	Innovation Theory	Design: Quantitative, Retrospective review, quasi-experimental Purpose: identify the impact of a CDS tool on screening rates for CT among female patients age 13-21; secondary goal of increasing provider awareness of screening guidelines, incorporating CDS treatment, follow-up, and education.	N= 27 pediatric primary care offices Demographics of patient screening: females, 13-21 years of age. asymptomatic for CT Setting: Primary care offices across Northeast Ohio Exclusions:	IV: CDS Tool and popup alerts DV: CT screening rates	CDS tools Pop-up alerts within the EHR Provider educational resources	Statistical test, pre-test posttest model, chi square analysis	P= 0.001 Odds ratio= 2.143 Confidence interval: 95%	Level of evidence: III Strengths: Increased % of asymptomatic patients were screened for CT Weaknesses: Retrospective review Setting is limited to primary care offices in Ohio Screening alerts in EHR are not linked to outside EHRs; if patient has +CT outside of the clinic it would not alert the provider Beneficial to clinical practice

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
(Miller et al., 2019) Development of a novel computerized clinical decision support system to improve adolescent sexual health care provision Country: United States Funding: NICHD K23 Award Bias: None stated	Innovation Theory	Design: Quantitative, mixed methodology, cross-sectional survey Purpose: develop a CDS system to facilitate evidence-based sexual health care for adolescents in the emergency department	n=57 clinicians, 23 physicians, 23 nurses, 11 nurse practitioners n=57 adolescents Demographics: 54% female, 40 years of age or older, adolescents 75% female, mean age of adolescents 16.2 years of age Setting: Four urban emergency departments	IV1: CDS tool IV2: Questionnaire DV1: Testing for pregnancy and STIs DV2: pregnancy prophylaxis with EC DV3: Counseling for safer sex behaviors DV4: treatment for previously diagnosed patient reported STIs DV5: Condom provision DV6: risky sexual behavior	Questionnaire survey CDS system	chi-square test	More favorable ratings pf CDS systems in general p=0.008 more agreement with asking about sexual health p=0.002 offering condoms p=0.025 testing for STIs/pregnancy p=0.004	Level of evidence: II Strengths: increased speed/efficiency, improve health care delivery, Weaknesses: limited time to fully use CDS, CDS tool only used within an emergency department setting, Beneficial to clinical practice for improved management of STIs and pregnancy

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
(Arbogast et al., 2017) Improving Primary Care Provider Practices in Youth Concussion Management Country: United States of America Funding: US Department of Health and Human Services, Centers for Disease Control and Prevention, Children's Hospital of Philadelphia Bias: None	Innovation Theory	Design: Quantitative, quasi-experimental Purpose: Improve primary care provider management of concussions	n= 14,527 pre and post intervention Demographics: age 0-19 years Setting: Primary care office	IV1: Vestibular oculomotor examination performed IV2: RTL/RTP guidelines discussed DV1: Patient age DV2: Patient sex DV3: Patient race DV4: Presence of other injuries DV5: first concussion visit	CDS tool in-person training	Pearson chi-square tests	Confidence interval= 95% adjusted odds ratio	Level of evidence: III Strengths: Improved provider behavior amongst concussion patients Weaknesses: Study only done at one specific primary care office
(Kharbanda et al., 2018) Clinical decision support for recognition and management of	Innovation Theory	Design: Cluster randomized trial Purpose: Evaluation of whether an electronic health record linked CDS could improve the recognition and	N= 461 IG: 256 CG: 205	IV1: CDS DV1: provider recognition of HTN	TeenBP CDS Clinical documentation assesses through chart reviews	Pearson's x2 test, Fisher's exact test, independent sample t test, linear mixed model	P= 0.001 Clinical recognition of HTN (IG) P= 0.046 Evaluation of secondary	Level of evidence: II Strengths: improved recognition of HTN

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
hypertension: A randomized trial Country: United States of America Funding: National Institutes of Health Bias: None stated		management of hypertension in adolescents	Demographics: Age between 10-17 years of age Female Setting: 20 different primary care clinics Exclusion: Previous lipid disorder Lipid test in the past year Previous HTN diagnosis	DV2: Lipid screening completed DV3: Referral to dietician or weight loss or exercise program DV4: antihypertensive medication within 6 months of meeting criteria Definitions: Hypertension Electronic-health record CDS	Provider satisfaction of CDS- $50 gift card given with each survey		causes of HTN (IG) P= 0.001 referral to dietician or weight loss program (IG) P= 0.003 Lipid screening completed (IG) P= 0.48 antihypertensive medication within 6 months of meeting criteria (IG)	Increased referrals to dieticians and cholesterol screening Weakness: Majority of patients were of white race Only girls were included in the study Feasibility: Beneficial to clinical practice
(Pell at el., 2020) Primary care management of lower Urinary tract Symptoms in men: protocol for development and validation of a	Innovation Theory	Design: quantitative, prospective, diagnostic accuracy Purpose: which number of index tests used in combination best predict three urodynamic observations in men who	n= 880 Setting: Primary care Demographics: Men, 16 years of age or older, present to general	IV: CDS tool DV1: decreased LUTS	Index tests, invasive urodynamics, bladder diary, uroflowmetry, CDS tool	BOO index, bladder contractility index, multivariable logistic regression model, Rubin's rule	p= 0.157 CI= 95% Attrition rate: 20-25%	Level of evidence: II Strengths: Potential for better management of LUTS Weaknesses:

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
diagnostic and clinical decision support tool (the PriMUS study) Country: United Kingdom Funding: National Institute for Health Research and Cardiff University Bias: Publication bias		present to their general practitioner with LUTS	practitioner with a complaint of one or more bothersome LUTS, able and willing to give informed consent for participation in the study, able and willing to undergo all index tests and reference test Exclusions: neurological disease or injury affecting lower urinary tract function, LUTS secondary to current or past invasive treatment or radiotherapy for pelvic disease, contraindications to urodynamics, indwelling catheter, inability to consent in					Some test results might be missing or have an inability to be obtained Results might be different when applied to practice Feasibility: Beneficial to practice that a CDS tool is beneficial for management of different diagnoses seen in the primary care clinic

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
			English or Welsh					
(Palen et al., 2019) Randomized Clinical Trial of a Clinical Decision Support Tool for Improving the Appropriateness Scores for Ordering Imaging Studies in Primary and Specialty Care Ambulatory Clinics Country United States Funding: Kaiser Permanente Colorado and the Colorado Permanente Medical Group	Innovation theory	Design: quantitative, Cluster randomized trial Purpose: evaluate whether the use of CDS tool improved the appropriateness scores of orders for advanced imaging in clinical practice	N= 23 n=22,279 Setting: integrated health care system Demographics: physicians and nonphysicians who order advanced imaging studies	IV: CDS tool DV1: MRI order DV2: CT order DV3: Appropriateness scores	CDS tool	Binary, mixed models,	CI- 95% p=0.001	Level of evidence: II Strengths: provider appropriate ordering of imaging increased Weaknesses: study was done at one specific clinic

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
Bias: Sampling bias								
(Connelly & Bickel, 2020) Primary Care Access to an Online Decision Support Tool is Associated with Improvements in Some Aspects of Pediatric Migraine Care Country: United States Funding: Pfizer independent grants Bias: Publication bias	Innovation Theory	Design: quantitative, observational study Purpose: To evaluate whether primary care provider access to an online decision support tool is associated with a change in evidence-based primary care medical management of pediatric migraine.	N=20 n=300 Setting: pediatric PCPs in pediatric community in Kansas		CDS tool, EHR	Two tailed tests	changes in appropriate abortive medication prescriptions for migraine management- p=0.01 Changes in Appropriate Preventive Medication Prescriptions for Migraine Management- p=0.01 Changes in Inappropriate Medication Prescriptions for Migraine Management- p=0.09	Level of evidence: VI Strengths: increased rates of proper management of migraines decreased rates of prescribing the wrong medication Weaknesses: CDS was used upon one clinical setting for pediatrics Feasibility: study provides evidence that CDS usage within the clinical setting can be effective

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
(Siaki et al., 2021) Feasibility of a Clinical Decision Support Tool to Manage Resistant Hypertension: Team-HTN, a Single-arm Pilot Study Country: United States Funding: Telemedicine and Advanced Technology Research Center, Advanced Medical Technology Initiative Bias: selection bias, information bias	Innovation model	Design: quantitative, nonrandomized, single arm Purpose: determine the feasibility of a web-based CDS using a renin-aldosterone system (RAS) classification matrix and drug sequencing algorithm to assist providers with the diagnosis and management of uncontrolled HTN	n= 54 patients n= 16 providers Demographics; patients: 18 years of age or older, cognitively intact, able to consent, taking 3 or more antihypertensive medications for more than 1 month. Providers: full time, current credentials, prescribing privileges. Exclusions: patient: unable to give consent in English, pregnant or breastfeeding woman, prisoners, patients on renal dialysis, transplant	IV: CDS tool DV1: controlled blood pressure rates DV2: provider management time DV3: end-user satisfaction	Blood pressure measurements, CDS tool, renin-aldosterone classification matrix, drug sequencing algorithm, satisfaction scores	Kolmogorov-Smirnov and Shapiro goodness-of-fit tests, two-sided fisher exact test	Change in rates of BP control $p=0.005$	Level of evidence: III Grade 3 Strengths: decreased patient BP readings Weaknesses: small sample size, time constraints with providers having to learn a new EHR system which hindered providers from wanting to participate Feasibility: useful within the clinical setting

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N-** Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
			patients, chronic disease, life expectancy less then 1-year, active duty					
(Kessler et al., 2017) Impact of electronic clinical decision support on adherence to guideline-recommended treatment for hyperlipidemia, atrial fibrillation and heart failure: protocol for a cluster randomized trial Country: United States Funding: None stated	Innovation model	Design: Quantitative, cluster randomized, non-blinded Purpose: to test whether a CDS improves the management of hyperlipidemia, atrial fibrillation and heart failure by primary care clinicians.	N= 20 Setting: primary care practice sites	IV: CDS tool DV1; improved management of hyperlipidemia DV2: improved management of heart failure DV3: improved management of heart failure	Provider survey, CDS tool	Rao-cramer adjusted X2 test, generalized estimating equation model	Level of significance: 0.05	Level of evidence: II Strengths: development of CDS tool Weaknesses: CDS tool not available to nonaffiliated clinics Feasibility: Beneficial to clinical practice

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N-** Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Citation	Theory/ Conceptual Framework	Design/Method/Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice/ Generalization
Bias: selection bias								
(Cox et al., 2020) Integrated Management Program Advancing Community Treatment of Atrial Fibrillation (IMPACT-AF): A cluster randomized trial of a computerized clinical decision support tool Country: Canada Bias: Publication bias Funding: Bayer Inc	Innovation model	Design: Quantitative, cluster randomized trial Purpose: We assessed whether computerized CDS for primary care providers would improve atrial fibrillation management and outcomes as compared to usual care.	n= 203 primary care providers n=1145 adult patients Setting: primary care clinic Demographics: 18 years of age, documented past or management of AF, can communicate in English	IV: CDS tool DV1: safety outcomes DV2: primary and secondary outcomes	CDS tool	Generalized estimating equations	primary efficacy p=0.926 safety p=.939	Level of evidence:II Strengths: Better patient management and safety Weaknesses; CDS tool did not improve atrial fibrillation management Feasibility: evidence into the developmental needs of CDS tools

Key: AF- atrial fibrillation; **BP-** Blood pressure; **CDS**- Clinical decision support; **CG-** Control group; **CT**- Chlamydia; **DV**- Dependent variable; **EC-** Emergency contraception; **EHR**- Electronic health record; **HTN-** Hypertension; **IG-** Intervention group; **IV-** Independent variable; **LUTS-** Lower urinary tract symptoms; **N**- Number of studies; **n-** Number of participants; **PCPs-** primary care providers; **RTL/RTP-** return-to-learn/return-to-play; **STIs-** Sexually transmitted infections

Table A2

Synthesis Table

Study (Author, Year)	Karas et al., 2018	Miller et al., 2019	Arbogast et al., 2017	Kharbanda et al., 2018	Pell at el., 2020	Palen et al., 2019	Connelly & Bickel, 2020	Siaki et al., 2021	Kessler et al., 2017	Cox et al., 2020
Sample										
n	27	57	14,527	461	880	22,279	300	70	20	1,348
Country	United States	United States	United States	United States	UK	United States	United States	United States	United States	Canada
Setting										
Primary Care	X		X	X	X	X	X	X	X	X
Emergency Care		X								
Design/LOE	Quant/III	Quant/II	Quant/III	Quant/II	Quant/II	Quant/II	Quant/VI	Quant/III	Quant/II	Quant/II
Interventions										
CDS Tool	+	+	+	+	+	+	+	+	+	+
Questionnaire		+								
Vestibular Oculomotor Exam			+							
Findings										
Improved patient management	X	X	X	X	X	X	X	X	X	X

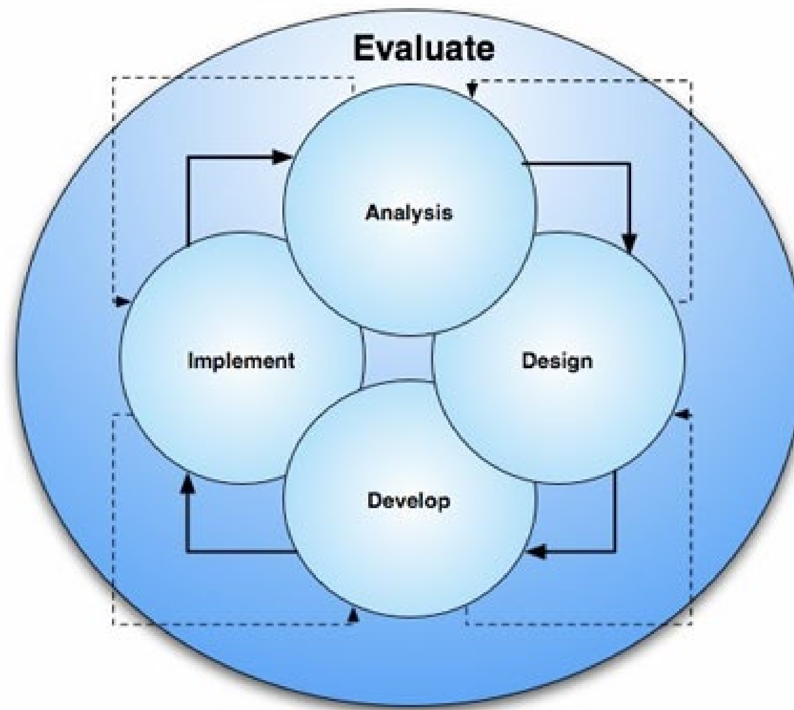
CDS- Clinical decision support; **LOE-** Level of evidence; **n-** Number of participants/studies

Appendix B

Frameworks and Models

Figure B1

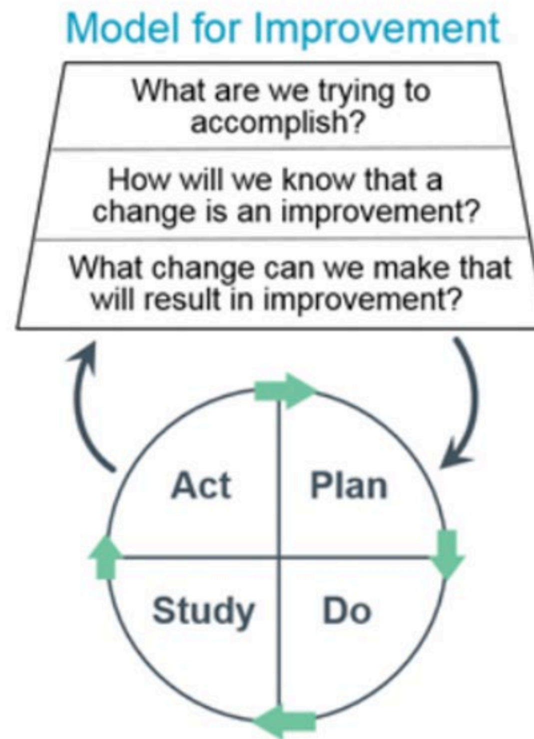
General Systems Theory



(Bertalanffy, 1950)

Figure B2

Plan-Do-Study-Act (PDSA) Model



(Shewart, 1993)

Appendix C

Tools

Figure C1

Clinical Decision Support Tool

History of Present Illness

-:

Patient presents for positive ***.

Review of Systems

General/Constitutional:

Patient denies abdominal pain, fever.

Gastrointestinal:

Patient denies vomiting , diarrhea , constipation.

Genitourinary:

Patient denies painful urination , frequent urination , pain in lower back.

Women Only:

Patient denies vaginal discharge/itching.

Examination

General Examination:

GENERAL APPEARANCE in no acute distress.
SKIN: grossly normal.
LUNGS: unlabored.
NEUROLOGIC: alert and oriented.
PSYCH: good eye contact , judgement and insight good.

Assessments

1. Sexually transmissible disease - A64 (Primary)

Treatment

1. Sexually transmissible disease

Clinical Notes: -Counseled on results, transmission and management plans, and future prevention.
-Encouraged condoms. Condoms prescription sent/Condoms prescription declined**
-Treatment per CDC guidelines. Written information provided.
-Discussed management of sexual partners. Expedited Partner Therapy (EPT) ** (provided for ***, Declined). Instructed to abstain from sexual activity for 7 days after treatment and until all sex partners are adequately treated (7 days after receiving treatment and resolution of symptoms). Instructed to refer their sex partners for evaluation and treatment.
-Counseled on testing for other STIs per CDC recommendations: **(accepts and ordered; declines; already tested).
-Discussed follow up per CDC recommendations.
-Health department notified via Communicable Disease Report for Healthcare Providers as per clinic protocol.

Figure C2

STI Chart Audit Tool

Identity Number	Age	Gender	Race	Ethnicity	STI Result	Clinic	CDS Tool Used	Tx per CDC Guidelines	Partner Tx	EPT	Other STI Screening Discussed	Other STI Screening Ordered	Safe Sex Practices	Condoms Offered	Documented Follow-Up	Follow-Up Testing Completed in Recommended Time Frame	Reporting to ADHS
1																	
2																	
3																	
4																	
5																	

Abbreviations

- ADHS= Arizona Department of Health Services
- CDC= Centers for Disease Control and Prevention
- EPT= Expedited Partner Therapy
- STI= Sexually Transmitted Infection
- Tx= Treatment
- PO= Orally
- BID- Twice a day
- IM- Intramuscularly

Appendix D

Data Charts

Figure D1

Demographics

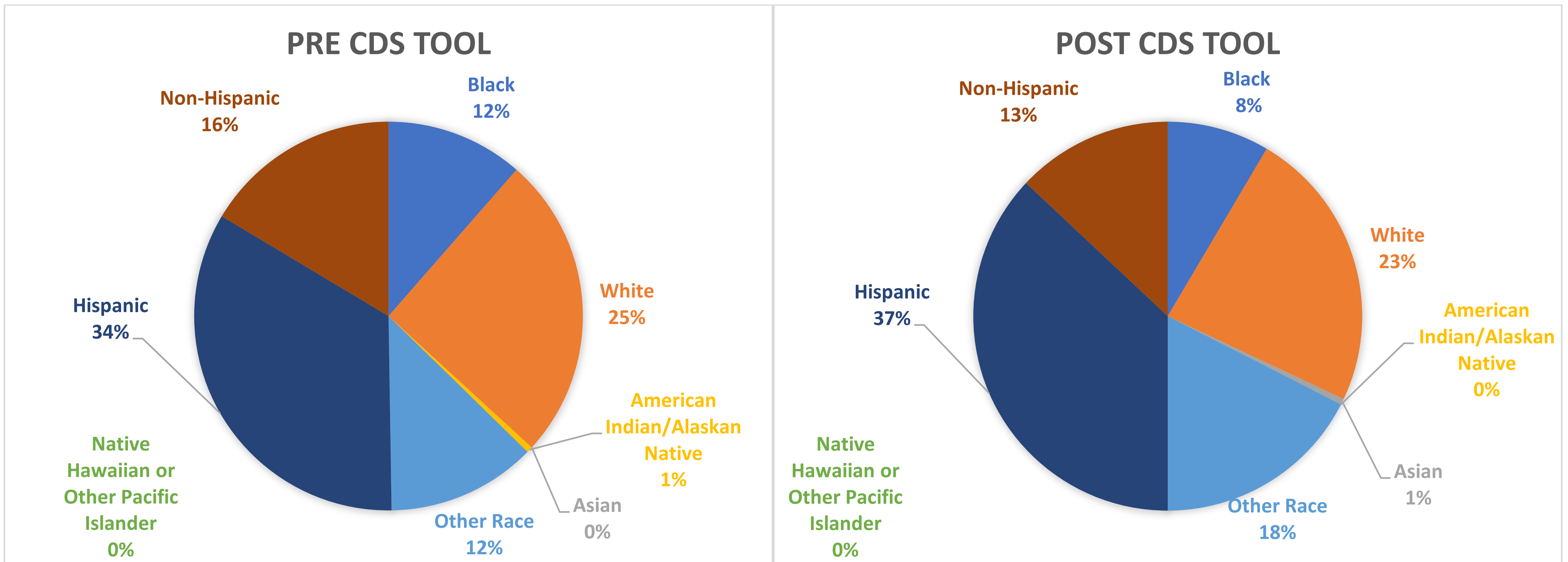


Figure D2

STI Treatment

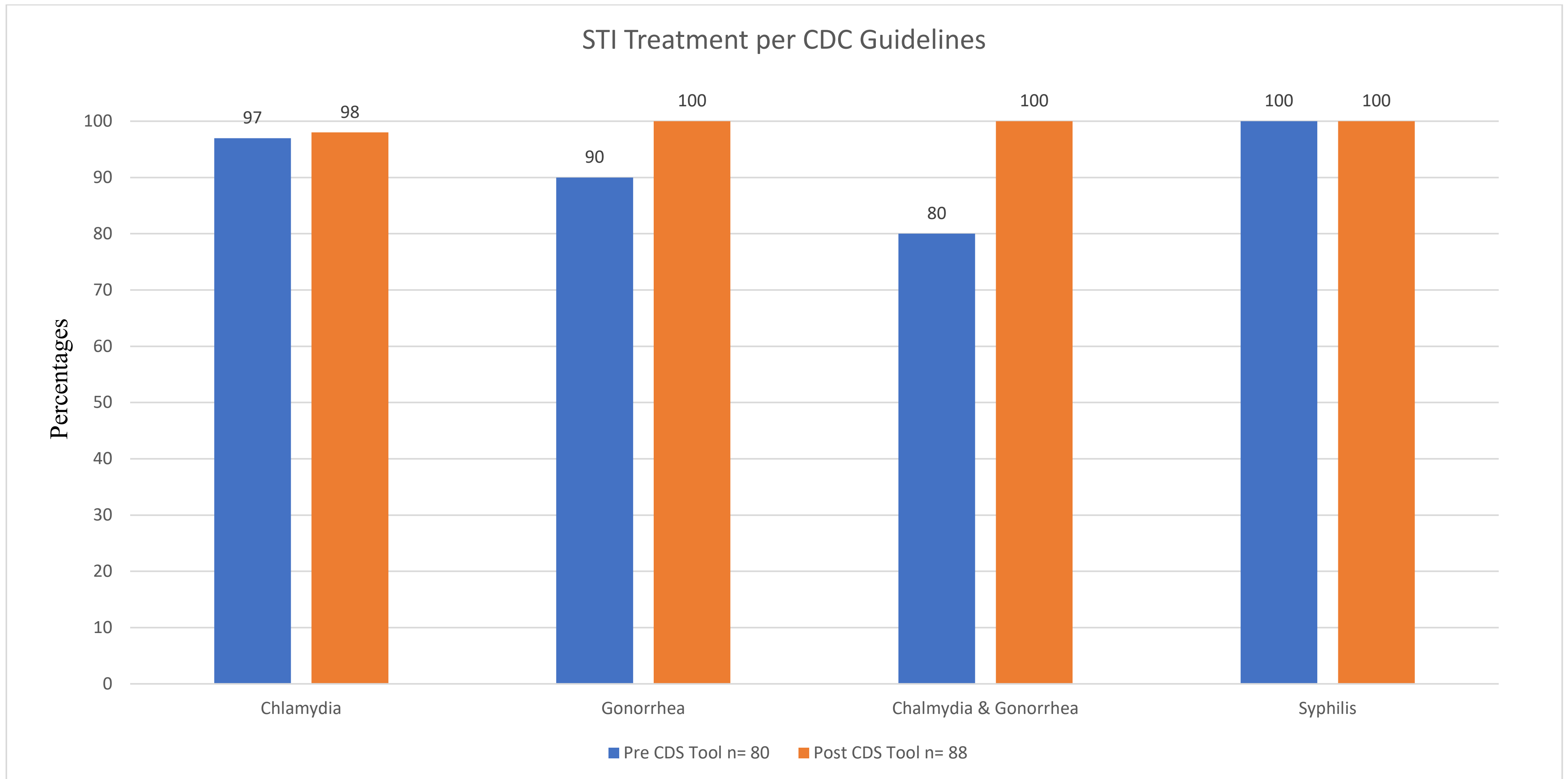


Figure D3

Pre and Post CDS Tool Chart Audits