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Healthcare Provider Education on Oseltamivir Resistance and Centers for Disease Control and Prevention Prescription Guidelines of Oseltamivir for Influenza

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Healthcare Provider Education on Oseltamivir Resistance and Centers for Disease Control and Prevention Prescription Guidelines of Oseltamivir for Influenza

A dissertation submitted in partial satisfaction of the

requirements for the degree

Doctor of Nursing Practice

by

Deeba Freshta Kazempoor

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ABSTRACT OF THE DISSERTATION

Healthcare Provider Education on Oseltamivir Resistance and Centers for Disease Control and Prevention Prescription Guidelines of Oseltamivir for Influenza

by

Deeba Freshta Kazempoor

Doctor of Nursing Practice

University of California, Los Angeles

Professor Wendie Robbins, Chair

Background: Oseltamivir treatment for influenza should begin within 48 hours of symptom onset; however, there is no significant benefit or data supporting the use of Oseltamivir beyond the 48-hour window in otherwise healthy adults. There are many reasons for inappropriate usage of antiviral prescriptions, including providers' lack of knowledge regarding guideline recommendations for antiviral use for influenza, the belief that prescribing medications may have some benefit, and the need to satisfy patient wants by prescribing a medication for a viral illness other than influenza. The most commonly prescribed antiviral for influenza in urgent care settings is Oseltamivir. The problem is that providers are prescribing Oseltamivir when it is not

appropriate and not in accordance with the Centers for Disease Control and Prevention (CDC) prescribing guidelines, which can impact antiviral resistance. **Objective**: The purpose of this study was to determine whether urgent care providers' knowledge about Oseltamivir, Oseltamivir resistance, and current CDC prescribing recommendations would increase after implementation of a short, one-on-one educational intervention. **Methods:** This quality improvement (QI) project enrolled providers working in urgent care clinics. Pre-intervention questionnaires collected baseline knowledge about Oseltamivir, followed by a 15-minute, one-on-one educational presentation on Oseltamivir. Post-intervention questionnaires were collected four weeks after the educational intervention. Statistical analysis consisted of Wilcoxon signed-rank tests. **Results:** The pre-intervention knowledge scores had a mean of 35.8%, whereas the post-intervention knowledge scores revealed a mean score of 65%, p=0.012 **Conclusion:** The project was feasible and essential in identifying the gaps in healthcare providers' knowledge about Oseltamivir and appropriate prescription usage of Oseltamivir for influenza. The end goal was for prescribers to be aware of best practices and CDC guidelines to improve patient's health and well-being.

The dissertation of Deeba Freshta Kazempoor is approved.

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2021

This dissertation is dedicated to my family. To my parents Nadim and Noorya, thank you for always standing by me throughout my academic journey. You both have instilled the importance of education since I was a little girl and I always strived to make you proud parents. To my siblings: Diana, Jasmine and Tony, thank you for always showering me with support and love; you inspire me each day to work harder than the day before. To my loving fiancé, Aryan, you are my biggest supporter and I could not have done this without your love and support; you are my rock, my everything. I love you all wholeheartedly.

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CHAPTER ONE: INTRODUCTION

Healthcare Provider Education on Oseltamivir Resistance and CDC Prescription Guidelines of Oseltamivir for Influenza

There are more than 30 million annual outpatient visits made in the United States (U.S.) for influenza or influenza-like illnesses, with a direct medical cost of approximately $10.4 billion (Schauer et al., 2016). Although influenza is viral and often self-limiting, it is highly contagious and its symptoms can incapacitate one from performing daily activities. There are medications, such as Oseltamivir, that are approved by the Food and Drug Administration (FDA) that help slow the viral replication and thus decrease the severity of symptoms caused by influenza A and B (Zachary, 2019). The Infectious Diseases Society of America (IDSA) and the CDC suggest that treatment for influenza with Oseltamivir should begin within the first 48 hours of symptom onset. Furthermore, no significant benefits or data have been shown to support the use of Oseltamivir in otherwise healthy adults beyond the suggested 48-hour window (McQuade & Blair, 2015). The CDC suggests that influenza treatment with antivirals should be reserved for those at high risk for influenza complications such as: children less than 2 years of age, adults 65 years and older, individuals with comorbidities (e.g., asthma), those who are immunocompromised, pregnant women, postpartum women, nursing home residents, morbidly obese individuals, and individuals of American Indian or Alaskan Native descent (CDC, 2017). Providers must also consider the patient's age, weight, and renal function when prescribing Oseltamivir (CDC, 2017). Moreover, the misuse of Oseltamivir can contribute to Oseltamivir resistance; in many instances, providers may prescribe Oseltamivir for healthy adults both beyond the suggested 48-hour window and without performing a confirmatory diagnostic test for influenza. Some reasons for providers misuse of antiviral prescriptions include: lack of

knowledge regarding guideline recommendations for Oseltamivir or influenza, the belief that an antiviral medication may benefit a patient's illness beyond the suggested 48-hour window, and the need to comply with patient requests or expectations (McQuade & Blair, 2015). Moreover, El Ramahi and Freifeld (2019) suggest that the development of antiviral resistance for current drugs used to treat influenza is a significant concern for immunocompromised individuals who require prompt treatment for influenza. The goal of the QI project was to increase provider knowledge and adherence to CDC's Oseltamivir prescription guidelines.

Problem Statement and PICOT Question

Healthcare providers are inappropriately prescribing Oseltamivir, or are not following CDC prescription guidelines set forth for Oseltamivir, therefore contributing to antiviral resistance and its misuse. Due to the prevalence of Oseltamivir resistance and its misuse, Oseltamivir may be ineffective for influenza treatment when it is needed. For the proposed Doctor of Nursing Practice (DNP) Scholarly Project, the PICOT question states: Does healthcare provider education on Oseltamivir resistance and CDC prescription guidelines on Oseltamivir, in the urgent care setting, improve provider knowledge and understanding of CDC prescription guidelines of Oseltamivir, over a four week time frame? The purpose of the QI project was to improve provider knowledge on Oseltamivir, and thus adherence to CDC prescription guidelines of Oseltamivir for influenza treatment in an urgent care setting.

Specific Aims

The aim of the project was to compare healthcare provider's knowledge pre and post-intervention, over a four-week time frame.

Scientific Underpinnings

The nursing profession has a strong scientific foundation that has evolved and gradually expanded the scientific underpinnings of the discipline (AACN, 2006). Given the clinical problem, the DNP Scholarly Project focused on how nursing actions and DNP prepared nurses can positively impact patient health outcomes by educating providers on Oseltamivir resistance and CDC prescription guidelines of Oseltamivir for influenza treatment. Thus, incorporating knowledge gained into one's clinical practice. DNP prepared nurses are able to evaluate and assess clinical problems, incorporate evidence-based practice (EBP) findings, and suggest solutions to improve patient health outcomes.

DNP Essentials

DNP Essential II highlights the necessity of organizational and systems leadership for QI and systems thinking for a DNP prepared nurse, which helps frame how the problem is carried out (AACN, 2006). This essential outlines the importance of DNP prepared nurses having the background, knowledge, and skills of working with a broad community and integrating new care delivery models (AACN, 2006). DNP prepared nurses are trained to be effective leaders in the community at a practice-level, as well as at a systems-level; and DNP leaders have the capability of creating change by complying with a systems thinking approach.

For the DNP Scholarly Project, incorporating DNP Essential II was crucial as it focuses on healthcare providers who are trying to create change within an organizational and systems level by learning more about Oseltamivir, Oseltamivir resistance, and CDC prescription guidelines of Oseltamivir in order to improve patient health outcomes. By applying DNP Essential II, the leaders within the project have the ability to understand and apply EBP findings to better the organization and patient outcomes. The providers involved in the project will ideally

be able to interact more proactively within a system and apply their learnings from the educational intervention at an organizational level by educating new hires or providers, and communicating findings within an organization and other systems.

CHAPTER TWO: THEORETICAL FRAMEWORK

The Plan-Do-Study-Act (PDSA) framework was applied to the QI project. The PDSA cycle is commonly used in QI projects and consists of a four-step model (Christoff, 2018). The first step consists of developing a plan and predicting outcomes. In the "plan" step of the DNP Scholarly Project, pre and post surveys were created to determine if the educational tool was effective. This step included planning for the educational intervention and PowerPoint presentation in order to assess providers' knowledge on Oseltamivir and its resistance.

The "do" step consists of the plan becoming implemented. In this step, the educational intervention was presented and pre and post-intervention surveys were collected from providers. The "study" step consists of data and results being obtained and analyzed. In this step, pre and post-intervention surveys were reviewed and quantitatively analyzed in order to determine if there was an increase in the providers' knowledge on Oseltamivir resistance and CDC prescription guidelines for Oseltamivir.

The last step of the PDSA cycle is "act", which includes either adopting or abandoning the QI project (Christoff, 2018). In this step, it was imperative to determine whether to adopt or abandon the educational intervention for healthcare providers. The DNP Scholarly Project underwent one cycle of the PDSA framework, in which the educational intervention improved providers' knowledge and understanding of Oseltamivir resistance and how to appropriately prescribe Oseltamivir for influenza treatment. Ultimately, the steps mentioned in the PDSA cycle are intended to improve patient outcomes and quality of life.

CHAPTER THREE: REVIEW OF LITERATURE

A literature search was conducted and different databases were scanned to find articles that helped support the PICOT question. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and diagram were created to help guide the systematic review and gather research articles that support the current problem. Databases used included UpToDate, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, and DynaMed. Search or key terms included: Tamiflu, Tamiflu resistance, Oseltamivir resistance, antiviral resistance, Oseltamivir education, and influenza treatment. Filters and search criteria included articles that were peer-reviewed, full text, and published within the past five years.

Search engines resulted in articles depicting the progression of Oseltamivir resistance, adverse effects of Oseltamivir, neuraminidase inhibitor usage, antiviral resistance, Oseltamivir use in high-risk populations, prevention of influenza, proper treatment and usage of Oseltamivir, and prescribing Oseltamivir outside labeled recommendations. The articles that were selected highlighted Oseltamivir's mechanism of action, prevalence of its resistance, its usage over the years, and provider and patient knowledge on the medication. If articles were used past the five-year time frame, it was deemed pertinent and crucial in addressing the current problem and necessary in pursuing the proposed project. The PRISMA analysis resulted in four quantitative and four qualitative research articles that help support the proposed PICOT question. These findings are further displayed in the Table of Evidence (TOE) below.

In a clinical article by Zachary (2019), the author compiled multiple studies that presented what Oseltamivir is as well as the benefits of its therapy, appropriate dosing, the effectiveness of Oseltamivir, patient education, and provider education. Studies revealed that Oseltamivir shows no benefits in patients treated for influenza-like symptoms without confirmed

influenza. Although many providers bypass the diagnostic testing route and prescribe Oseltamivir for influenza-like symptoms, there is no need for providers to prescribe Oseltamivir for patients who are not confirmed to have influenza.

Moreover, a clinical article by Boivin and Zachary (2019) examined Oseltamivir resistance and its etiology. In the 2008 to 2009 H1N1 influenza pandemic, Oseltamivir resistance became widespread due to the H275Y mutation (Boivin & Zachary, 2019). Oseltamivir is a neuraminidase inhibitor that works on the surface of influenza A and B by blocking the release of progeny, thus preventing viral replication from infected cells (Boivin & Zachary, 2019). Studies showed that Oseltamivir resistance can be caused by, or an outcome of, neuraminidase mutations such as the H275Y mutation. It is imperative for providers to have an understanding of Oseltamivir's mechanism of action and historical impact of resistance in order to appropriately prescribe for influenza.

Schauer et al. (2016) performed a cross-sectional study over a four-month period with 70 individuals in order to determine patient's perceptions on Oseltamivir's cost, efficacy, and adverse effects. Multiple choice and open response surveys were completed by caregivers and adult patients who presented to a rural emergency department (ED) for influenza-like symptoms. The study showed that providers were more inclined to prescribe an antiviral medication as a result of obtaining higher patient satisfaction scores and due to patient or caregiver demands (Schauer et al., 2016). More than 60% of the participants expressed positive expectations of Oseltamivir use and nearly all participants said if they knew about the adverse effects of Oseltamivir, it would have deterred them from wanting or requesting the medication. A limitation of the study included not knowing why patients refused to participate in the study. Also, there was a limited sample size and generalizability due to the fact that the study took place

in an ED, thus impacting the study's validity and reliability. However, the results were consistent and showed that there is a strong need for effective provider and patient communication on Oseltamivir use for influenza.

Roosenhoff et al. (2020) depicts the effect of a patient's age, viral load, antiviral therapy, drug resistance, and vaccination status on viral shedding in children. A total of 2,131 children were studied, all below the age of 14. The Influenza Resistance Information Study (IRIS) was a prospective, multi-centered, and non-randomized study where data was collected and analyzed from 2008 to 2015. The inclusion criteria changed for the last two years of the study to include only children below the age of 14 that were on antiviral therapy (Roosenhoff et al., 2020). Participant's locations varied across multiple countries, from the U.S., China, Australia, South Africa, and Europe. Clinical assessments were conducted on days one, six, and 10; and real-time reverse transcriptase polymerase chain reaction (RT-PCR) throat and nasal samples were collected on days one, three, six, and 10.

In the study, 683 of the patients were found to be positive for H1N1, 825 were positive for H3N2, and 623 were positive for influenza B, while 61% of the children received antivirals. The baseline viral load was significantly higher for children aged 10 to 13 positive for influenza B ($0.05>p>0.01$). The study revealed a relationship between age and duration of the virus shedding; specifically that younger children showed to have a longer median viral clearance time of 9.9 to 11.5 days in comparison to children above the age of five, which had a median range of 7.2 to nine days (Roosenhoff et al., 2020). Additionally, 185 participants reported adverse events, and 117 out of the 185 were being treated with an antiviral therapy. Fourteen of the participants reported serious adverse events, while 10 out of the 14 individuals were given Oseltamivir. Oseltamivir resistance was found to be higher in children under the age of five and

those who presented with antiviral resistance had higher viral loads at different intervals. The study showed that children under the age of five shed 1.04 to 1.24 times greater quantity of the influenza virus; while low viral clearance in the younger children may have been due to immature immune responses or lack of prior exposure to influenza viruses (Roosenhoff et al., 2020).

The study revealed that it is imperative for providers to have a better understanding of at-risk populations for influenza, influenza viral clearance and load in at-risk populations, Oseltamivir resistance, and how to appropriately prescribe Oseltamivir for children. Limitations of the study included the change in inclusion criteria during the last two years of the study; however, the study analyzed data from participants across the globe leading to generalizability, and showed consistent results over the years, thus proving validity and reliability. In the future, there is a need for a consistent study design and inclusion criteria for participants of all ages.

Chen et al. (2019) conducted a case study that explored the adverse events that occurred in a 57-year old adult patient treated with Oseltamivir for influenza A. According to Chen et al. (2019), many adverse effects of Oseltamivir have been reported in children and adolescents, including neuropsychiatric adverse effects such as behavioral disturbances and delirium. Oseltamivir is generally safe to use, however, neuropsychiatric events are possible and it is imperative to educate patients and healthcare providers on these symptoms. Limitations of the study included that the study focused on one patient, a low level of evidence, and lack of generalizability. Future studies suggest inclusion of more individuals who presented with adverse effects due to Oseltamivir use.

Van der Vries et al. (2016) reviewed different influenza B lineages and their responses to neuraminidase inhibitors. IRIS data was evaluated on patients with influenza B over five years,

and virus cultures were sequenced and phenotyped to distinguish virus lineage and neuraminidase inhibitor sensitivity, respectively; outcomes were then assessed using the Kaplan-Meir analysis method (Van der Vries et al., 2016). The study showed no difference in viral lineage in regards to the time it takes to clear the virus or the symptoms associated with influenza. The study consisted of a diverse population that included: men, women, children and adults. The samples obtained from patients were geographically heterogeneous, covering Asia, Australia, Europe, and North America (Van der Vries et al., 2016). Due to the study being performed in various settings, amongst various populations, with consistent results and generalizability, the study can be shown to be valid and reliable. This study allows providers to have an understanding of the different influenza B viral lineages, influenza viral loads, duration of influenza symptoms, influenza viral clearance, and antiviral susceptibility. Additionally, the study revealed that influenza treatment was dependent on healthcare providers; therefore, provider education on set guidelines for Oseltamivir use should be implemented.

Koo et al. (2016) assessed the effectiveness of an educational intervention in increasing healthcare workers' knowledge on infection prevention in various nursing homes. The Targeted Infection Program (TIP) intervention was developed to help reduce multidrug-resistant organism (MDRO) infections associated with indwelling devices; focusing on barrier precautions, surveillance of MDROs, and staff education on infection prevention. Over 200 in-services were conducted and included 211 to 375 healthcare workers. The study was a cluster randomized and multi-component intervention that took place in Southeast Michigan and consisted of a control group that continued to practice as usual, or according to their own infection prevention protocols. Ten educational modules were presented during in-services to participants, which included didactic education and interactive strategies.

Pre and post-tests were conducted and scores were compared using a paired t-test. Between the control group and intervention group, the pre-test scores were fairly the same (mean difference 1.2%; $p>0.05$); however, post-test scores improved ($p<0.001$), showing the educational intervention modules were effective in their content and delivery method (Koo et al., 2016). Limitations to the study included the fact that there were very few studies evaluating the effectiveness of educational interventions in nursing home healthcare workers, there were no post-tests conducted with the control group, and there were high turnover rates with healthcare workers in the nursing home settings. Future studies should be aimed towards educating individuals tailored to their job description. The study was conducted in Southeast Michigan where there may be a variation in availability of patient beds and resources; thus, results may not be generalizable to other long-term care facilities across the globe. However, results were consistent with a sufficient sample size, thus impacting validity and reliability. Ultimately, the study revealed the positive impact of an educational intervention in understanding and applying EBP findings to better patient health outcomes.

Apisarnthanarak and Mundy (2008) evaluated 150 surveys from physicians across multiple medical disciplines to determine how influenza is screened and treated for. The surveys, which consisted of 65 questions, were conducted from July to December 2006 and showed that 60% of participants believed that antiviral agents for influenza lowered mortality. Whereas 40% of the participants believed using an antiviral medication for influenza could prevent bacterial complications and infections from occurring, 25% of the participants felt that antiviral medications decreased the duration of influenza symptoms, and 10% believed there were no significant clinical benefits in prescribing antiviral medications for influenza (Apisarnthanarak & Mundy, 2008). Limitations of the study were that respondents might have been biased in their

responses and a lack of a broader geographical population since the study was retrospective and only included physicians from two different hospitals in Thailand. However, there was a sufficient sample size with consistent results, thus proving validity and reliability. Ultimately, the study revealed that healthcare providers should have an understanding of EBP findings and guidelines set forth for influenza screening and treatment in order to improve patient outcomes.

Linder et al. (2006) conducted a retrospective analysis from October 2000 to May 2004, which evaluated primary care providers' prescription usage for adults with influenza. The study, which took place in Boston and included nine primary care clinics, included patients with a diagnosis of influenza or patients who were given an electronic prescription for an antiviral medication for influenza. Linder et al. (2006) determined that 70% of the antiviral prescriptions for influenza were appropriately prescribed and that providers more readily prescribed antiviral medications for influenza with a positive influenza diagnostic test and influenza symptoms such as myalgia. An antiviral medication was not prescribed for 87 individuals, 21 of which would have potentially benefited from an antiviral agent and met the appropriate criteria for influenza treatment. Reasons for the inappropriate prescription usage of antiviral medications include providers being unaware of the 48-hour effective window period and overall guidelines for influenza, the belief that patients may benefit from antiviral medications beyond the 48-hour window, and the belief that patients should be prescribed a medication for a viral condition. Limitations of the study included that the definition of appropriateness was broad and there was a small sample size of participants, thus limiting power. However, the study showed consistent findings over approximately four years and evaluated multiple primary care settings, thus proving validity and reliability. This study shows that there is a need for provider education on appropriate prescription usage of Oseltamivir and other antivirals for influenza treatment.

Bonner et al. (2003) conducted a randomized controlled study, which reviewed the effect of providers' treatment and plan of care for influenza given knowledge of rapid diagnostic test results. The study was conducted in a children's hospital ED and consisted of a total of 391 patients, whose ages spanned between two months to 21-years old. Patients were divided into two groups, Group one included patients whose providers were aware of the influenza diagnostic test results and Group two included patients whose providers were not aware of the influenza diagnostic test results. Given the rapid influenza diagnostic test results, Group one providers had a decrease in usage of other diagnostics tests (e.g., chest radiographs or urinalysis), length of stay in ED, and antibiotic usage. Additionally, Group one patients were appropriately prescribed an antiviral medication for influenza. Rapid diagnostic tests for influenza A and B have been shown to be both sensitive and specific; and as a result of these tests, there has been a reduction in excessive laboratory testing, which ultimately reduces additional or unnecessary patient charges. These tests have also allowed for a reduction in inappropriate antibiotic usage and have improved appropriate antiviral prescription usage for at-risk populations (Bonner et al., 2003). The study's limitations included a small sample size of young patients and implications for future studies encouraged the inclusion of more children under the age of 36 months and adults. However, the study showed consistent results over time and was conducted in a children's hospital allowing results to be generalizable to other pediatric hospitals, thus proving validity and reliability. Healthcare providers' understanding of guidelines on influenza diagnostic testing and antiviral prescriptions can help appropriately diagnose and treat individuals diagnosed with influenza in a more efficient and timely manner.

Synthesis of Literature Review

Common themes found in the literature were that antiviral resistance is underestimated and that providers are prescribing Oseltamivir inappropriately. Boivin and Zachary (2019), Zachary (2019), and Van der Vries et al. (2016), discuss the historical impact of influenza and the growing antiviral resistance rates associated with Oseltamivir and appropriate populations to prescribe the medication to. In all of the literature review findings, healthcare providers were found to either show non-compliance to guidelines set forth in the workplace or lack of knowledge on the set criteria.

The studies by Schauer et al. (2016) and Chen et al. (2019) emphasized the importance of education on adverse effects of Oseltamivir and its potential impact on one's health. Roosenhoff et al. (2020) and Bonner et al. (2003) evaluated various components associated with influenza in pediatric patients in order to determine the impact of rapid diagnostic testing, viral load, viral clearance, etc. By doing so, the authors were able to demonstrate which populations were at highest risk for influenza complications and who would benefit most from Oseltamivir.

The research reviewed was consistent in supporting the need for education about the indications for Oseltamivir and its resistance, as many providers are either unaware of CDC guidelines associated with Oseltamivir prescription usage or do not follow the guidelines for various reasons. In the articles by Apisarnthanarak and Mundy (2008), Koo et al. (2016), and Linder et al. (2006), the authors evaluated both healthcare providers' and healthcare workers' knowledge on antiviral treatment for influenza and infection prevention, respectively. Although the methodologies were different in each of the studies, the authors revealed that provider education is necessary in incorporating EBP findings into one's practice and improving patient

health outcomes. The articles by Bonner et al. (2003) and Koo et al. (2016) were randomized controlled trials, and thus provide strong evidence in supporting the DNP Scholarly Project.

Given the literature findings, DNP prepared nurses are able to apply their knowledge of practice policies and procedures, QI strategies, and ability to address ethical dilemmas in order to improve patient health outcomes and ensure patient safety (AACN, 2006). As leaders, DNP prepared nurses are trained to create new care models, expand on their creative mindsets, continue taking risks to improve patient outcomes, inspire others, and ultimately apply learned knowledge to improve healthcare outcomes and create change (Jenkins, 2020). Gathering research and implementing a QI project in one's clinical practice based on EBP findings requires an interdisciplinary team that communicates well. Essentially, the articles reviewed above allow DNP prepared nurses to evaluate adherence to prescription guidelines and educate providers on Oseltamivir in order to improve patient healthcare outcomes.

Gaps in Literature and Limitations of Published Studies

Research demonstrates the presence of antiviral resistance associated with Oseltamivir; however, there is little data identifying the prevalence of individuals impacted by Oseltamivir resistance. The literature evaluated covers both adults and children, however, there were more publications related to the pediatric population. Also, many of the research articles evaluated physicians' perceptions or knowledge on Oseltamivir. Future studies would suggest inclusion of other healthcare providers such as nurse practitioners (NPs) and physician assistants (PAs), in addition to physicians, to better assess how most healthcare providers practice. Limitations to the studies reviewed included a lack of variation in ages, small power or sample sizes, lack of generalizability due to settings, and lack of inclusion of all healthcare professionals who are able to prescribe Oseltamivir.

CHAPTER FOUR: METHODS

Design

The QI project used a pre and post-intervention design to improve provider knowledge on Oseltamivir resistance and adherence to CDC prescription guidelines using an Oseltamivir Education (OE) intervention. The goals and aims of the study were for providers to appropriately prescribe Oseltamivir according to set CDC guidelines, which include prescribing Oseltamivir during the appropriate time frame, for patients at-risk for complications from influenza, and to those who could benefit from its usage. The study hypothesized that healthcare providers would have an improved understanding about Oseltamivir, its resistance, and improved adherence to CDC guidelines following the OE intervention. The Oseltamivir Knowledge Questionnaire (OKQ) was administered via Google Forms immediately before the OE intervention and again four weeks post-intervention.

Setting and Sample

The study was conducted at four urgent care settings near Long Beach, California. Teams of healthcare providers rotate through the different clinical sites. These healthcare providers treat patients with diverse socioeconomic and cultural backgrounds. Inclusion criteria for the study were urgent care healthcare providers, whereas exclusion criteria were anyone who did not meet the above criteria. All providers who worked at the four urgent care clinics and met the eligibility criteria were invited to participate in the study. A total of 10 healthcare providers who met the eligibility criteria agreed to participate in the QI project.

Educational Intervention

The OE intervention was developed in collaboration with content experts in the focus area. Interviews with content experts were conducted and included an urgent care nurse

practitioner, pharmacist, and the medical director of the urgent care. The OE consisted of an in-person or video conference that included a 15-minute PowerPoint presentation designed to provide information on when and who to prescribe Oseltamivir to, Oseltamivir resistance, and how adherence to CDC prescription guidelines of Oseltamivir for influenza treatment can lead to improved patient outcomes (see Appendix A). The OE was presented to healthcare providers in a one-to-one setting. When the OE was conducted in person, it took place in the provider's office to help minimize distractions.

Data Collection

Healthcare providers were given a quick response (QR) code to scan, which led them to the pre-intervention OKQ. The OKQ was completed on Google Forms and collected information on three different categories: the healthcare provider's demographics, content knowledge, and perceptions. It is imperative to note that prior to implementation of the DNP Scholarly Project, a pilot test was completed on the OKQ, which was conducted by 10 healthcare providers, showing content validity. The demographic portion of the questionnaire consisted of information pertaining to the provider's profession, age range, and years of experience as a healthcare provider. The OKQ knowledge questions were created based on literature review findings and content expert interviews. The 12 knowledge questions aimed at assessing the provider's knowledge on Oseltamivir, Oseltamivir resistance, and CDC prescription guidelines of Oseltamivir for influenza, adverse effects of Oseltamivir, at-risk populations that could benefit from Oseltamivir, diagnostic testing of influenza and its impact on prescribing Oseltamivir, etc. The knowledge questions were presented in various formats including: multiple choice, select all that apply, and true or false. The perception questions aimed at trying to understand the impact of COVID-19 on the provider's prescribing habits and their knowledge of the CDC prescription

guidelines of Oseltamivir for influenza treatment. Providers completed the pre-intervention OKQ in approximately five minutes. See Appendix B for the pre-intervention Oseltamivir questionnaire from Google Forms.

The OE was provided immediately after the providers completed the pre-intervention OKQ. One month later, providers were emailed a link to complete the post-intervention OKQ via Google Forms, which consisted of the same knowledge questions (see Appendix C). The perception questions varied slightly, in order to determine if the OE was effective in improving knowledge four weeks later. All participants completed a pre and a post-intervention questionnaire. Personally identifying data that was used to contact and schedule providers for the interviews was destroyed leaving only de-identified data for analysis. The Institutional Review Board (IRB) identified the QI project as "not human subjects research" and therefore did not require a certification of exemption or IRB review.

Statistical Analysis

Healthcare provider demographic information and OKQ answers on the pre and post-test were entered into an excel file for data management and analysis. Demographic data was summarized as number and percent for categorical data (see Table 1). To test for a pre and post-test difference in content knowledge on CDC prescription guidelines for Oseltamivir for influenza treatment, each response on the questionnaire was assigned either '1' (correct) or '0' (incorrect). A sum of correct answers on the knowledge and prescribing domains was calculated for each participant pre-intervention and again post-intervention. In addition, a total sum correct across all of the questions was calculated for each participant pre-intervention and post-intervention and presented as total number or percent correct. The score data was continuous, but non-normally distributed; therefore, a non-parametric test was considered. The score data was

tested for skew and kurtosis, but neither test was significant, therefore the non-parametric Wilcoxon signed-rank test was used to test for a difference between pre and post intervention scores (Rosner, 2016). If the sample size had been larger, a paired t-test would have been used, however, the sample size was 10. The overall conclusions regarding significant differences between pre and post-test scores were the same using either the Wilcoxon signed-rank test or paired t-test. Level of significance was set at $p < 0.05$.

CHAPTER FIVE: RESULTS

The aim of this study was to determine if an educational intervention on Oseltamivir would help improve provider knowledge and adherence to CDC guidelines for Oseltamivir use for influenza treatment. A pre and post intervention questionnaire was administered to 10 urgent care healthcare providers and collected data on participant demographics and knowledge on Oseltamivir for influenza treatment. Also, perception questions on adherence to CDC guidelines for prescribing Oseltamivir and the impact of COVID-19 on prescribing habits were collected. The same 10 healthcare providers participated both in the pre and post-intervention questionnaire.

Demographics

Forty percent of the healthcare providers were between the ages of 51 to 65 years, 30% were between the ages of 36 to 50, and the remaining 30% were between the ages of 20 to 35 years. Professional roles of the providers were: 60% NPs, 30% PAs, and 10% medical doctors (MDs). Provider years of experience were: 70% with 10 years or less of experience, 30% split evenly between 11 to 20 years, 21 to 30 years, and greater than 30 years of experience. Demographic findings are shown in Table 1.

Knowledge Questions

Pre and post intervention questionnaires assessed knowledge of Oseltamivir resistance and CDC prescription guidelines. The pre-intervention knowledge scores revealed the following: mean score 35.8% and range of 16.7% to 50%. The post-intervention knowledge scores revealed the following: mean score of 65% and range of 33.3% to 83.3%. There was a 29.2% increase in post-intervention knowledge scores compared to pre-intervention, p=0.012. This demonstrated that there was an improvement from pre to post-intervention knowledge scores and that providers gained a greater understanding of CDC guidelines for Oseltamivir use for influenza.

High Risk Populations for Influenza Complications

The first question asked participants to identify individuals considered being at high risk for influenza complications, and who can benefit from Oseltamivir usage for influenza treatment. Answer choices allowed participants to select all that apply. The pre-intervention questionnaire revealed that 0/10 (0%) of the participants chose the correct answer (Nursing home residents and American Indians and Alaska Natives). However, 10/10 (100%) of the participants did choose "Nursing home residents" and 4/10 (40%) chose "American Indians and Alaska Natives". Moreover, the post-intervention questionnaire revealed that 1/10 (10%) of the participants chose the correct answer. In the post-intervention questionnaire, all the participants' selected "Nursing home residents" and 9/10 (90%) selected "American Indians and Alaska Natives".

Oseltamivir's Medication Classification

The second question was a multiple-choice question that asked about the Oseltamivir's medication classification. The pre-intervention questionnaire results revealed that 6/10 (60%) of the participants chose the correct answer of "neuraminidase inhibitor", while the remaining 4/10 (40%) chose between "adamantanes" and "nucleoside reverse transcriptase inhibitors".

Moreover, 10/10 (100%) of the participants selected the correct answer in the post-intervention questionnaire.

Time Frame to Prescribe Oseltamivir

The third question was presented in a multiple-choice format that asked about the time frame recommended for administering Oseltamivir. In the pre-intervention questionnaire results, 8/10 (80%) of the participants selected the correct answer of "Within 48 hours of symptom onset", whereas the remaining 2/10 (20%) selected "Within 72 hours of symptom onset". However, 9/10 (90%) of the participants selected the correct answer in the post-intervention questionnaire and 1/10 (10%) of participants selected the answer "Within 72 hours of symptom onset".

Influenza Virus Testing Methods

The fourth question was in the select all that apply format. The question allowed participants to select the different influenza virus testing methods. In the pre-intervention questionnaire, 9/10 (90%) of the participants chose "Rapid Influenza Diagnostic Tests (RIDTs)", 7/10 (70%) chose "RT-PCR" 3/10 (30%) "Immunofluorescence Assays", and 2/10 (20%) "Rapid Molecular Assays". In the pre-intervention questionnaire, only 1/10 (10%) of the participants selected the correct answer of all four options. However, 7/10 (70%) of the participants selected the correct answer in the post-intervention questionnaire "Rapid Molecular Assays", 10/10 (100%) selected "RT-PCR" 8/10 (80%) selected "RIDTs", and 8/10 (80%) selected "Immunofluorescence Assays".

Causes of Resistance

The fifth question was a multiple-choice question and asked about a mutation that caused Oseltamivir resistance. In the pre-intervention questionnaire, 10/10 (100%) of the participants

selected “H4N1”, whereas the correct answer was the “H275Y” mutation. However, 7/10 (70%) of the participants selected the correct answer of “H275Y” in the post-intervention questionnaire, whereas the remaining 3/10 (30%) of the participants selected “H4N1”.

Considerations for High Risk Outpatients

The sixth question was presented in the select all that apply format that allowed participants to identify considerations for prescribing Oseltamivir in high-risk outpatients populations. In the pre-intervention questionnaire results, 2/10 (20%) of the participants selected the correct answer of “Patient’s disease severity”, “Patient’s age”, and “Patient’s disease progression”. 5/10 (50%) of the participants chose “Patient’s disease severity”, 4/10 (40%) chose “Patients age”, 2/10 (20%) chose “Patients disease progression”, and 6/10 (60%) selected “All of the above”. However, 6/10 (60%) of the participants selected the correct answer in the post-intervention questionnaire. In the post-intervention questionnaire, 5/10 (50%) of participants chose “Patient’s disease severity”, 5/10 (50%) of chose “Patient’s age”, 6/10 (60%) chose “Patient’s disease progression”, and 4/10 (40%) chose “All of the above”.

Children at Highest Risk

The seventh question was a multiple-choice option that asked about children who are at highest risk for complications from influenza. Although children less than five are at high risk for influenza complications, children less than the age of two are at highest risk. In the pre-intervention questionnaire, 2/10 (20%) of the participants selected the correct answer of “2”, whereas the remaining 6/10 (60%) and 2/10 (20%) selected “1” and “3”, respectively. However, in the post-intervention questionnaire, 7/10 (70%) of the participants selected the correct answer of “2”, whereas the remaining 3/10 (30%) selected “1”.

Benefits of Oseltamivir

The eighth question was presented in a multiple-choice format and asked about the benefits of Oseltamivir use for influenza treatment. In the pre-intervention questionnaire results, 0/10 (0%) of the participants selected the correct answer. 7/10 (70%) of the participants selected "Neither A or B", and the remaining 3/10 (30%) selected "Both A & B". Option A stated "Oseltamivir can shorten the duration of influenza illness by 5 to 6 days" and option B stated "Oseltamivir can reduce antibiotic usage and ear infection occurrences in children aged 1 to 12". Moreover, 6/10 (60%) of the participants selected the correct answer in the post-intervention questionnaire. Whereas the remaining 3/10 (30%) selected "Both A & B" and 1/10 (10%) selected "Neither A or B" in the post-intervention questionnaire.

Oseltamivir and COVID Treatment

The ninth question was presented in a true or false format that asked about whether Oseltamivir is effective in treating Coronavirus Disease-19 (COVID-19). In the pre-intervention questionnaire results, 9/10 (90%) of the participants selected the correct answer of "False", whereas the remaining 1/10 (10%) selected "True". Moreover, the results remained the same in the post-intervention questionnaire for the ninth question.

Oseltamivir as a Treatment for Influenza

The 10th question was presented in a true or false format that asked about the mechanism of action of Oseltamivir and what it treats. In the pre-intervention questionnaire results, 9/10 (90%) of the participants selected the correct answer "True", whereas the remaining 1/10 (10%) selected "False". In the post-intervention questionnaire, 10/10 (100%) of the participants selected the correct answer, "True".

Oseltamivir Resistance

The 11th question was presented in a select all that apply format and asked about which statements were true regarding Oseltamivir. In the pre-intervention questionnaire results, 2/10 (20%) of the participants selected the correct answers which were: “Oseltamivir resistance can occur in immunosuppressed individuals and young children”, “Resistance to Oseltamivir can occur during or after treatment for influenza”, and “A neuropsychiatric event is an adverse effect of Oseltamivir”. 2/10 (20%) selected “Oseltamivir resistance can occur in immunosuppressed individuals and young children.”, 7/10 (70%) selected “Resistance to Oseltamivir can occur during or after treatment for influenza.”, 2/10 (20%) selected “A neuropsychiatric event is an adverse effect of Oseltamivir.”, and 2/10 (20%) of the participants selected the option of “None of the above”. In the post-intervention questionnaire, 2/10 (20%) of the participants selected the correct answer. 2/10 (20%) of the participants selected “Oseltamivir resistance can occur in immunosuppressed individuals and young children.”, 4/10 (40%) selected “Resistance to Oseltamivir can occur during or after treatment for influenza.”, 6/10 (60%) selected “A neuropsychiatric event is an adverse effect of Oseltamivir.”, and 3/10 (30%) of the participants selected the option of “None of the above.”.

Considerations for Oseltamivir

The 12th question was presented in a select all that apply format that asked about provider considerations when prescribing Oseltamivir for influenza treatment. In the pre-intervention questionnaire results, 4/10 (40%) of the participants selected the correct answer which was “Patient’s age”, “Patient’s weight”, “Patient’s renal function”, and “Other health conditions of the patient”. Furthermore, 8/10 (80%) of participants selected “Patient’s age”, 7/10 (70%) selected “Patient’s weight”, 5/10 (50%) selected “Patient’s renal function”, 6/10 (60%) selected

"Other health conditions of the patient", and 1/10 (10%) selected "None of the above". In the post-intervention questionnaire, 5/10 (50%) of the participants selected the correct answer. 9/10 (90%) selected "Patient's age", 8/10 (80%) selected "Patient's weight", 7/10 (70%) selected "Patient's renal function", 7/10 (70%) selected "Other health conditions of the patient", and 0/10 (0%) selected "None of the above".

Pre-Post Intervention Scores

Scores are presented as number correct and or percent correct on the questionnaire. Wilcoxon signed-rank test was used to determine if there was a difference in scores from pre-test to post-test. Significance level set at $*p<0.05$. The scores for questions two, four, five, and eight were all below p-value <0.05, thus, were statistically significant. The overall post-test scores were also statistically significant, with p-value = 0.012. Pre and post-intervention scores per question are displayed in Table 2.

Perception Questions

The third portion of the pre-intervention questionnaire consisted of perception questions about the impact of COVID-19 on the provider's adherence to Oseltamivir prescription guidelines. When asked if COVID-19 has changed the way provider's prescribe Oseltamivir for influenza, 6/10 (60%) of the participants stated "No", whereas 4/10 (40%) indicated "Yes." For those who stated, "Yes", the follow up question requested participants to describe. From this qualitative question, responses varied and included the following: "Not prescribing as much. Seeing less flu.", "Prescribing less often.", and "Have not seen flu-like symptoms as often therefore do not consider treating flu as often.". Lastly, when asked if they felt well informed about the CDC guidelines related to Oseltamivir for influenza treatment, 9/10 (90%) responded "No", whereas 1/10 (10%) responded, "Yes".

In the post-intervention questionnaire, when asked if COVID-19 changed the way provider's prescribe Oseltamivir for influenza, 5/10 (50%) selected "Yes", whereas the remaining 5/10 (50%) selected "No". If participants responded with a "Yes", they were requested to describe. Post-intervention responses to this question included the following: "Have seen fewer flu like presentation of viral illness", "Covid-19 can cause complications such as flu", "d/t similar symptoms and decreased testing for influenza", "Covid-19 is most patient's greatest concern. Very few ask for Oseltamivir". In the post-intervention questionnaire, when asked if after four week post-intervention, they felt well informed about the CDC guidelines of Oseltamivir for influenza treatment, 10/10 (100%) of the participants selected "Yes". When asked if they always follow CDC guidelines four weeks post-intervention, 9/10 (90%) selected "Yes", whereas 1/10 (10%) selected "No".

Figure 1: *Knowledge Correct Answers by Question, Pre and Post-Intervention*

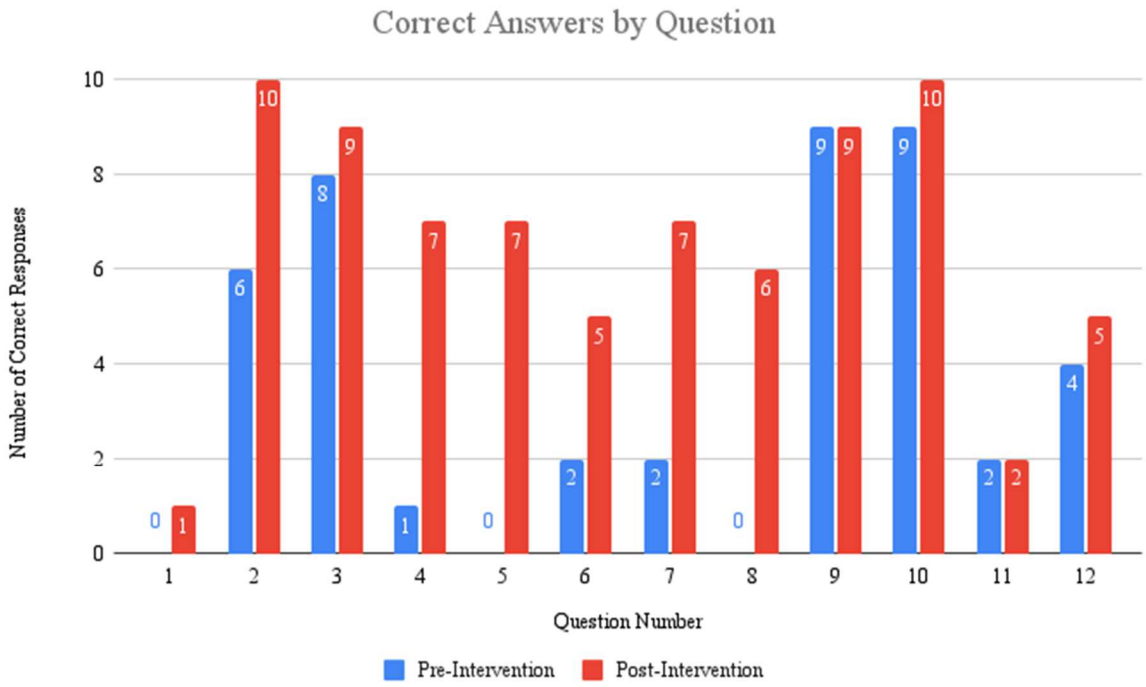


Figure 2: *Overall Knowledge Score Pre and Post-Intervention (N=10)*

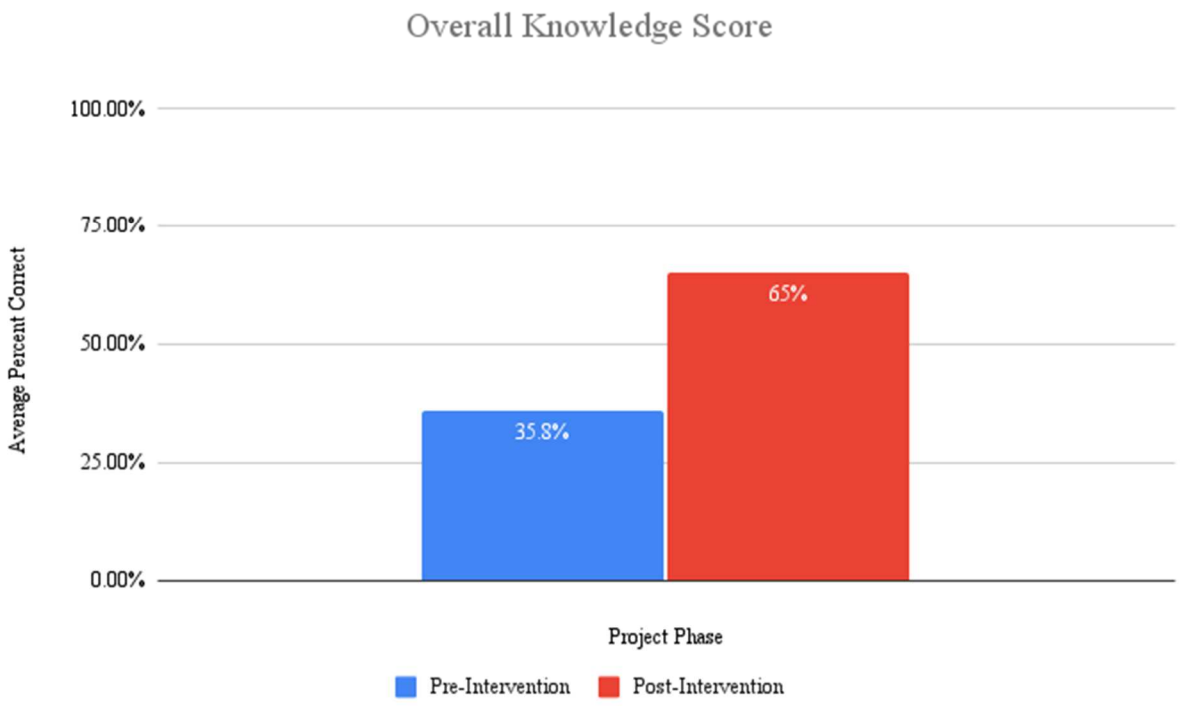


Table 1: *Frequency Counts for Demographic Variables*

Variable	Category	*n*	%
Age			
	20 to 35 years	3	30%
	36 to 50 years	3	30%
	51 to 65 years	4	40%
Profession			
	Nurse Practitioner (N.P.)	6	60%
	Physician Assistant (P.A.)	3	30%
	Medical Doctor (M.D.)	1	10%
Years of Experience			
	0-10 years	7	70%
	11-20 years	1	10%
	21-30 years	1	10%
	>30 years	1	10%

Table 2: *Number of Participants with Correct Answer per Question Pre-Post Intervention and Test for Pre-Post Change in Score (N=10)*

Topic of Questions 1-12	Response Types	Number of Participants with Correct Answer Pre-test	Number of Participants with Correct Answer Post-test	*p*-value
High Risk Populations for Influenza Complications	Select All That Apply	0	1	0.317
Oseltamivir's Medication Classification	Multiple Choice	6	10	0.046*
Time Frame to Prescribe Oseltamivir	Multiple Choice	8	9	0.563
Influenza Virus Testing Methods	Select All That Apply	1	7	0.014*
Causes of Resistance	Multiple Choice	0	7	0.008*
Considerations for High Risk Outpatients	Select All That Apply	2	5	0.179
Children at Highest Risk	Multiple Choice	2	7	0.096
Benefits of Oseltamivir	Multiple Choice	0	6	0.014*
Oseltamivir and COVID Treatment	True or False	9	9	1.000
Oseltamivir as a Treatment for Influenza	True or False	9	10	0.317
Oseltamivir Resistance	Select All That Apply	2	2	1.000
Considerations for Oseltamivir	Select All That Apply	4	5	0.706
Total		43	78	0.012*

Wilcoxon signed rank test for change in participants' scores pre-post intervention, *$p<0.05$

CHAPTER SIX: DISCUSSION

In the post-intervention questionnaire, most participants displayed a clear understanding around Oseltamivir's medication classification, mechanism of action, and the timeframe in which to prescribe the medication. In addition, many participants correctly selected nursing home residents, American Indians, and Alaska Natives as at-risk groups for complications of influenza; while some incorrectly included Southeast Asians and children less than the age of five in that list. It is also noted that many providers selected RIDT's as the only influenza testing method, which is likely due to the types of tests readily available at urgent care clinics.

As noted in the introduction and literature review, many healthcare providers were unaware of Oseltamivir resistance or why resistance may occur with an antiviral medication; which was evident in the pre-intervention questionnaire results. However, once providers were educated on the background of Oseltamivir resistance and causes of resistance, they both verbalized their understanding and displayed an improvement in their post-intervention questionnaire results.

COVID-19 left a lasting impression on provider's perceptions, as many noted that COVID-19 impacted their prescribing habits for influenza. Since providers were seeing less influenza patients, and were testing for COVID-19 more frequently than influenza, they perceived that they had been prescribing Oseltamivir less often. Upon completion of the educational intervention, many providers noted the education as being relevant to today's pandemic as well as being a great refresher on the topic of Oseltamivir and influenza. Moreover, many participants felt well-informed with CDC prescription guidelines of Oseltamivir for influenza treatment post-intervention; however, not all participants always followed CDC guidelines set forth for Oseltamivir use for influenza treatment, both pre and post-intervention.

Although there were variations in provider scores both pre and post-intervention, it is important to note that there was an increase in the total correct answers for all questions, except one. The question that participants did not improve their score was a select all that apply question that assessed the provider's understanding of which populations Oseltamivir resistance can occur in, when resistance occurs, and an adverse effect of Oseltamivir.

The result revealed there is a need for ongoing education for healthcare providers of EBP findings, including CDC guidelines. Given the 2020 pandemic, the CDC provided updated guidelines on how to effectively monitor and treat influenza and on the usage of Oseltamivir for influenza. By providing this information to healthcare providers, participants became well-informed on set CDC guidelines and became aware, or more aware of the resources that were readily offered to them by the CDC. Many of the participants verbalized they were unaware of any resistance associated with Oseltamivir. Moreover, there was a common theme of the participants stating the educational intervention was a good topic to review for clinical practice given the current pandemic and the impact it has had on their treatment for influenza.

Moreover, COVID-19 drastically impacted the reason for outpatient visits to the urgent care setting; far fewer influenza cases were seen nationwide. The U.S. Virologic Surveillance captured data from clinical laboratories nationwide and indicated the following for the 2020 to 2021 influenza season during the time period of September 2020 to May 1, 2021: there were a total of 989,837 specimens tested, in which 1,814 (0.2%) were positive specimens for influenza (CDC, 2021). Of those 1,814 positive influenza specimens, 666 (36.7%) were influenza A, while the remaining 1,148 (63.3%) were influenza B (CDC, 2021). Overall, more patients were presenting to the urgent care to be screened and tested for COVID-19, compared to influenza during the 2020 to 2021 influenza season.

It was hypothesized that averages on knowledge scores would improve in their post-interventional total survey scores. A statistically significant increase in knowledge scores shows the impactful findings of the DNP project. However, failure was possible if knowledge scores did not improve post intervention or remained the same as pre-intervention. If this were to have happened, it would have been imperative to re-evaluate the educational intervention questionnaire. The goal was for all prescribers to become knowledgeable around best practices and standardized practice of care to improve their patient's health and well-being. Moreover, sustainability of the project is key in ensuring that current and future healthcare providers at the studied clinical sites follow set clinic and CDC guidelines for Oseltamivir prescription usage.

Limitations

Limitations of the project included provider lack of interest or time in participating in the study and small sample size of providers. Future studies should promote inclusion of providers working in different settings and locations, such as primary care offices and other specialty settings in order to improve patient health outcomes on a greater scale. Also, providers may have had an understanding of the information provided, but might not practice based on EBP findings. Future studies on practice change are needed. Moreover, COVID-19 significantly impacted the implementation and outcome of the project. Influenza cases significantly dropped in the 2020 to 2021 influenza season, compared to the 2019 to 2020 influenza season. Initially, patients charts were to be reviewed and compared via the electronic medical record (EMR) for both influenza seasons listed above in order to determine provider adherence to CDC prescription guidelines of Oseltamivir, however, due to the COVID-19 pandemic, influenza cases were minimal to none in the clinical sites. The project's strengths include measuring the same providers pre and post-intervention which helps to control for potential confounding.

Implications for Practice

Educating providers on Oseltamivir resistance and appropriate prescription usage will help to provide quality, safe, and effective care to individuals diagnosed with influenza. It is imperative that providers have an understanding of set guidelines and criteria for treatment of influenza to better care for populations as a whole. In gaining this knowledge and understanding, providers can improve patient healthcare outcomes in one's clinical practice.

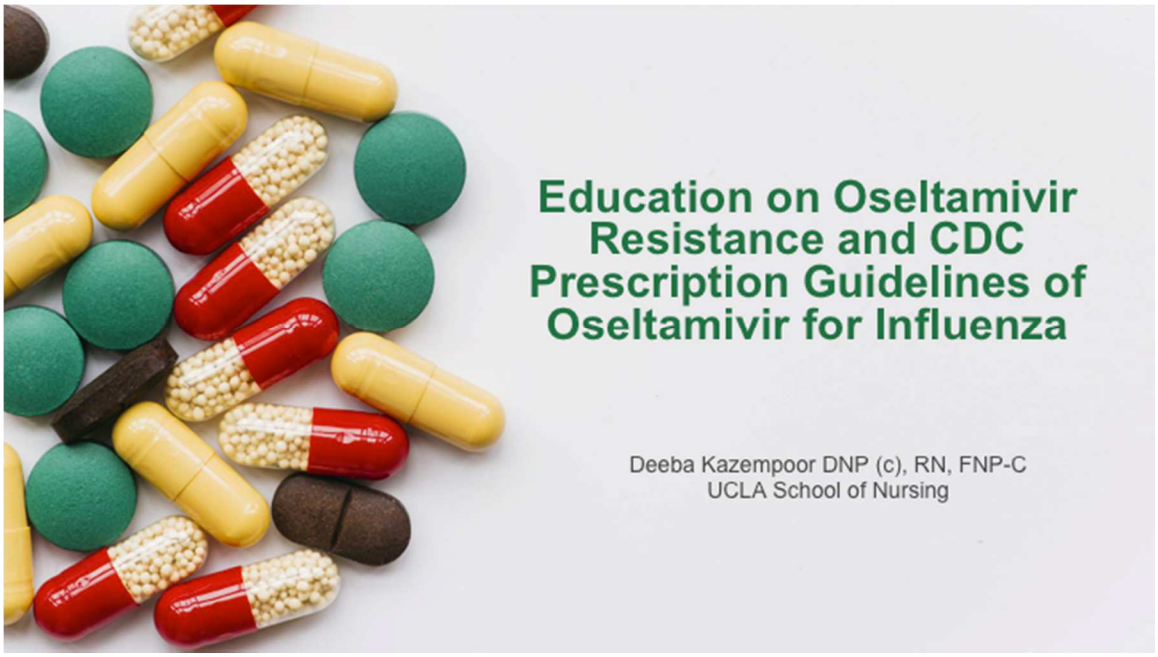
CONCLUSION

Although many healthcare providers are aware of antibiotic resistance, there is an ongoing need to educate providers on adherence of CDC prescription guidelines of Oseltamivir and Oseltamivir resistance. This QI project aimed at exploring provider's knowledge pre and post the OE, adherence to CDC guidelines for Oseltamivir use, and its resistance. Although there are numerous validity issues that must be addressed and acknowledged in order to identify barriers and gaps, the project proved feasible and essential in identifying healthcare providers' knowledge on Oseltamivir and appropriate prescription usage of Oseltamivir for influenza. The end goal is for prescribers to be aware of best practices and CDC guidelines to improve patient's health and well-being. Once this has been addressed, sustainability is crucially important and it will be imperative to implement this project yearly into the urgent care setting, and later expand into other healthcare organizations providing ambulatory care services.

APPENDICES

Appendix A

Oseltamivir Educational Intervention, PowerPoint Slides



Introduction/Background

- Influenza is a highly contagious viral illness and over the past 3 decades, influenza-related deaths have ranged from 1.4 to 16.7/100,000 individuals (mostly older adults).
- There are more than 30 million annual outpatient visits in the United States (U.S.) made for influenza-like illnesses, with a direct medical cost of approximately $10.4 billion.
- Total costs of income loss and premature mortality from a moderately severe influenza pandemic is approximately $570 billion annually.

(Schar et al., 2018)

Introduction/Background

- Antiviral treatment for influenza should begin within the first 48 hours of symptoms onset.
- There is no significant benefit or data supporting the use of Oseltamivir outside the 48-hour window in otherwise healthy adults.
- There are many reasons for inappropriate prescribing of antivirals including:
  - Providers not knowing the guidelines for Oseltamivir or antiviral use for influenza.
  - Belief that prescribing medications may have some benefit.
  - The need to satisfy patient wants by prescribing a medication for a viral illness.

(Boivin & Zachary, 2019)

Literature Review Findings

- In a study by Linder et al. (2006), only 70% of the antiviral prescriptions were deemed appropriate and 30% were inappropriate (21/87 individuals met criteria for appropriateness).
- The most common reasons for inappropriate antiviral prescriptions was symptom duration for longer than 2 days.

(Linder et al., 2006)

Literature Review Findings

- 60% of participants believed that antiviral agents for influenza lowered mortality.
- 40% believed using an antiviral medication for influenza could prevent bacterial complications.
- 25% of the participants felt that antiviral medications decreased the duration of influenza symptoms.
- 10% believed there were no significant clinical benefits in prescribing antiviral medications.

(Apisarnthanarak & Mundy, 2008)

Influenza Symptoms

- Fever
- Cough
- Sore throat
- Runny nose
- Congestion
- Body aches
- Headaches
- Chills
- Fatigue

(CDC, 2017)

What is Oseltamivir?

Neuraminidase Inhibitor

FDA approved

Used to treat Influenza A/B and chemoprophylaxis

(CDC, 2017)

Oseltamivir Resistance

- Influenza viruses changing.
- Oseltamivir can lose it's ability to bind to and inhibit the function of the virus's neuraminidase proteins.
- Domestic and global surveillance.
- Studies showed that Oseltamivir resistance can be caused by or an outcome of neuraminidase mutations, such as the H275Y mutation.

(CDC, 2017)

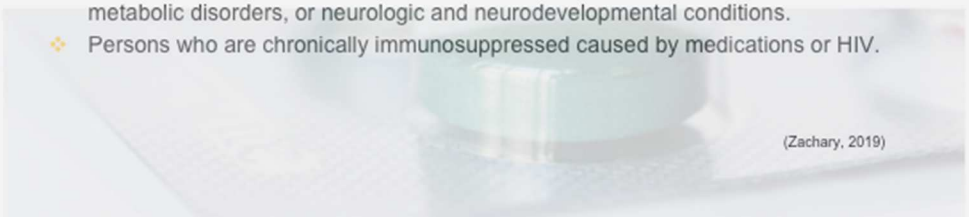
Considerations for Prescribing Oseltamivir for High Risk Outpatients

- Patient's disease severity
- Patient's disease progression
- Patients age
- Underlying medical conditions
- Likelihood of influenza
- Time of symptom onset

(CDC, 2017)

Populations at High Risk for Influenza Complications

- Children <2 years of age
- Adults 65 years of age or older.
- Pregnant women or postpartum (within 2 weeks of delivery)
- Persons < 19 years on chronic ASA therapy.
- American Indians/Alaska Natives
- Persons who are extremely obese
- Nursing home residents
- People with chronic pulmonary, cardiovascular, renal, hepatic, hematological, metabolic disorders, or neurologic and neurodevelopmental conditions.
- Persons who are chronically immunosuppressed caused by medications or HIV.



(Zachary, 2019)

Benefits of Oseltamivir

- Can make flu symptoms milder
- Can shorten duration of illness
- In children between 1-12 years old, can reduce incidence of ear infections and antibiotic use
- May reduce flu-related complications

(CDC, 2017)

Adverse Events of Oseltamivir

01 Serious skin reactions

02 Neuropsychiatric events

03 Headaches

04 Delirium

(CDC, 2017)

Common Side Effects of Oseltamivir

01 Nausea

02 Vomiting

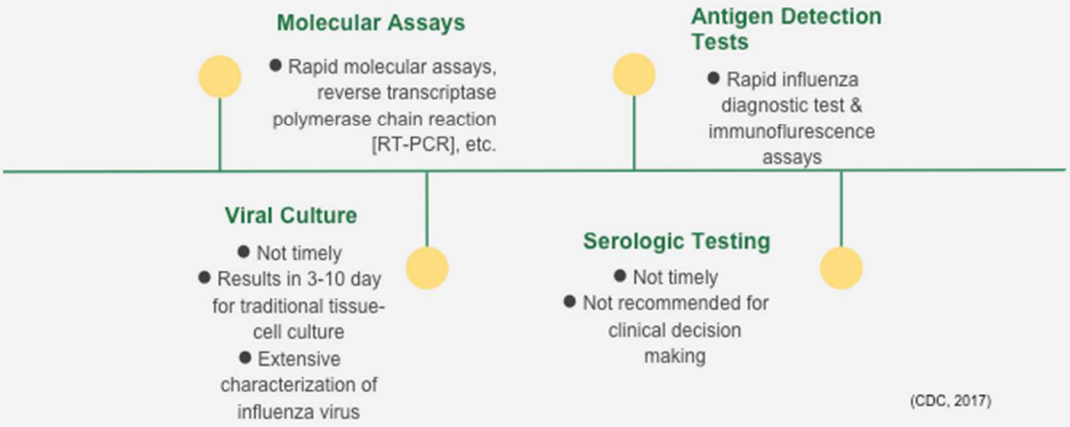
(CDC, 2017)

Oseltamivir Treatment in Healthy Outpatients

- Antiviral treatment can be considered in healthy, symptomatic outpatients who *are not* at high risk with a suspected or confirmed influenza, on the basis of clinical judgment (within 48 hours of symptoms onset).

(CDC, 2017)

Influenza Virus Testing Methods



(CDC, 2017)

Co-circulation of Influenza and SARS CoV-2:

- During periods of co-circulation of influenza and SARS CoV-2, empiric antiviral treatment for influenza is recommended for priority groups including: hospitalized patients with respiratory illnesses, outpatients with severe and complicated respiratory illnesses, and outpatients at higher risk for influenza complications.
- Healthcare providers should not wait for influenza or SARS CoV-2 testing results to initiate empiric antiviral treatment for influenza in the above priority groups.
- A positive influenza test result does not preclude a SARS CoV-2 infection.

(CDC, 2021)

Questions?

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Appendix B

Oseltamivir Knowledge Questionnaire, Pre-Intervention given via Google Forms

Oseltamivir Knowledge and Perception Questionnaire for Influenza Treatment (Pre-Intervention)

Demographic Information

* Required

1. Please select your age range: *

Mark only one oval.

- ◯ 20-35 years old
- ◯ 36-50 years old
- ◯ 51-65 years old
- ◯ >65 years old

2. Please select your profession: *

Mark only one oval.

- ◯ Nurse Practitioner (N.P.)
- ◯ Physician Assistant (P.A.)
- ◯ Medical Doctor (M.D.)
- ◯ Doctor of Osteopathic Medicine (D.O.)

3. Please select your years of healthcare experience as a provider: *

Mark only one oval.

- ◯ 0-10 years
- ◯ 11-20 years
- ◯ 21-30 years
- ◯ >30 years

Knowledge Questions

4. Which of the following are considered high-risk populations for influenza complications and recommended for antiviral treatment? Select all that apply. *

Check all that apply.

- ☐ Nursing home residents.
- ☐ American Indians and Alaska Natives.
- ☐ Southeast Asians.
- ☐ Children younger than 5 years of age.

5. What is Oseltamivir's medication classification? *

Mark only one oval.

- ◯ Cap-dependent endonuclease inhibitor
- ◯ Adamantanes
- ◯ Neuraminidase inhibitor
- ◯ Nucleoside reverse transcriptase inhibitor

6. It is recommended that Oseltamivir be prescribed to specific patient populations diagnosed with influenza A or B within what time frame? *

Mark only one oval.

- ◯ Within 48 hours of symptom onset
- ◯ Within 72 hours of symptom onset
- ◯ Up to 5 days of symptom onset
- ◯ Up to 6 days of symptom onset

7. What are influenza virus testing methods? Select all that apply. *

Check all that apply.

- [ ] Rapid Molecular Assays
- [ ] Reverse Transcription-Polymerase Chain Reaction (RT-PCR)
- [ ] Rapid Influenza Diagnostic Tests (RIDTs)
- [ ] Immunofluorescence Assays

8. Oseltamivir resistance became widespread due to the _____ mutation. *

Mark only one oval.

- ◯ I223V
- ◯ H275Y
- ◯ S247N
- ◯ H4N1

9. Considerations for prescribing Oseltamivir in high-risk outpatients include: (Select all that apply) *

Check all that apply.

- [ ] Patient's disease severity
- [ ] Patient's age
- [ ] Patient's disease progression
- [ ] Patient's gender
- [ ] All of the above

10. Children less than the age of 5 are considered at high risk for complications from influenza, however, children less than the age of _____ are at the highest risk. *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4

11. Benefits of Oseltamivir use for influenza treatment may include: *

Mark only one oval.

- ◯ Oseltamivir can shorten the duration of influenza illness by 5 to 6 days.
- ◯ Oseltamivir can reduce antibiotic usage and ear infection occurrences in children aged 1 to 12.
- ◯ Both A & B.
- ◯ Neither A or B.

12. True or False. Oseltamivir use has been shown to be effective for treatment of COVID-19. *

Mark only one oval.

- ◯ True
- ◯ False

13. True or false. Oseltamivir is a neuraminidase inhibitor and has activity against influenza A and B viruses. *

Mark only one oval.

- ◯ True
- ◯ False

14. Which of the following statements are true regarding influenza and Oseltamivir? Select all that apply. *

Check all that apply.

- [ ] Oseltamivir resistance can occur in immunosuppressed individuals and young children.
- [ ] Resistance to Oseltamivir can occur during or after treatment for influenza.
- [ ] A neuropsychiatric event is an adverse effect of Oseltamivir.
- [ ] None of the above.

15. Providers must consider the following when considering the use of an antiviral medication such as Oseltamivir for influenza. Select all that apply. *

Check all that apply.

- [ ] Patient's age.
- [ ] Patient's weight.
- [ ] Patient's renal function.
- [ ] Other health conditions of the patient.
- [ ] None of the above.

Perception Questions

16. Has COVID-19 and SARS-CoV2 changed the way you prescribe Oseltamivir for influenza? *

Mark only one oval.

- ◯ Yes
- ◯ No

17. If yes to the previous question, please describe how below.

_____

_____

_____

_____

_____

18. Do you feel well informed about the CDC guidelines of Oseltamivir for influenza treatment? *

Mark only one oval.

- ◯ Yes
- ◯ No

19. Do you always follow the CDC guidelines of Oseltamivir for influenza treatment? *

Mark only one oval.

- ◯ Yes
- ◯ No

Appendix C

Oseltamivir Knowledge Questionnaire, Post-Intervention given via Google Forms

Oseltamivir Knowledge and Perception Questionnaire for Influenza Treatment (Post-Intervention)

Demographic Information

* Required

1. Please select your age range: *

Mark only one oval.

- ◯ 20-35 years old
- ◯ 36-50 years old
- ◯ 51-65 years old
- ◯ >65 years old

2. Please select your profession: *

Mark only one oval.

- ◯ Nurse Practitioner (N.P.)
- ◯ Physician Assistant (P.A.)
- ◯ Medical Doctor (M.D.)
- ◯ Doctor of Osteopathic Medicine (D.O.)

3. Please select your years of healthcare experience as a provider: *

Mark only one oval.

- ◯ 0-10 years
- ◯ 11-20 years
- ◯ 21-30 years
- ◯ >30 years

Knowledge Questions

4. Which of the following are considered high-risk populations for influenza complications and recommended for antiviral treatment? Select all that apply. *

Check all that apply.

- ☐ Nursing home residents.
- ☐ American Indians and Alaska Natives.
- ☐ Southeast Asians.
- ☐ Children younger than 5 years of age.

5. What is Oseltamivir's medication classification? *

Mark only one oval.

- ◯ Cap-dependent endonuclease inhibitor
- ◯ Adamantanes
- ◯ Neuraminidase inhibitor
- ◯ Nucleoside reverse transcriptase inhibitor

6. It is recommended that Oseltamivir be prescribed to specific patient populations diagnosed with influenza A or B within what time frame? *

Mark only one oval.

- ◯ Within 48 hours of symptom onset
- ◯ Within 72 hours of symptom onset
- ◯ Up to 5 days of symptom onset
- ◯ Up to 6 days of symptom onset

7. What are influenza virus testing methods? Select all that apply. *

Check all that apply.

- [ ] Rapid Molecular Assays
- [ ] Reverse Transcription-Polymerase Chain Reaction (RT-PCR)
- [ ] Rapid Influenza Diagnostic Tests (RIDTs)
- [ ] Immunofluorescence Assays

8. Oseltamivir resistance became widespread due to the _____ mutation. *

Mark only one oval.

- ◯ I223V
- ◯ H275Y
- ◯ S247N
- ◯ H4N1

9. Considerations for prescribing Oseltamivir in high-risk outpatients include: (Select all that apply) *

Check all that apply.

- [ ] Patient's disease severity
- [ ] Patient's age
- [ ] Patient's disease progression
- [ ] Patient's gender
- [ ] All of the above

10. Children less than the age of 5 are considered at high risk for complications from influenza, however, children less than the age of _____ are at the highest risk. *

Mark only one oval.

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4

11. Benefits of Oseltamivir use for influenza treatment may include: *

Mark only one oval.

- ◯ Oseltamivir can shorten the duration of influenza illness by 5 to 6 days.
- ◯ Oseltamivir can reduce antibiotic usage and ear infection occurrences in children aged 1 to 12.
- ◯ Both A & B.
- ◯ Neither A or B.

12. True or False. Oseltamivir use has been shown to be effective for treatment of COVID-19. *

Mark only one oval.

- ◯ True
- ◯ False

13. True or false. Oseltamivir is a neuraminidase inhibitor and has activity against influenza A and B viruses. *

Mark only one oval.

- ◯ True
- ◯ False

14. Which of the following statements are true regarding influenza and Oseltamivir? Select all that apply. *

Check all that apply.

- [ ] Oseltamivir resistance can occur in immunosuppressed individuals and young children.
- [ ] Resistance to Oseltamivir can occur during or after treatment for influenza.
- [ ] A neuropsychiatric event is an adverse effect of Oseltamivir.
- [ ] None of the above.

15. Providers must consider the following when considering the use of an antiviral medications such as Oseltamivir for influenza. Select all that apply. *

Check all that apply.

- [ ] Patient's age.
- [ ] Patient's weight.
- [ ] Patient's renal function.
- [ ] Other health conditions of the patient.
- [ ] None of the above.

Perception Questions

16. Has COVID-19 and SARS-CoV2 changed the way you prescribe Oseltamivir for influenza? *

Mark only one oval.

- ◯ Yes
- ◯ No

17. If yes to the previous question, please describe how below.

_____

_____

_____

_____

_____

18. Since the educational intervention 4 weeks ago, do you feel well informed about the CDC guidelines of Oseltamivir for influenza treatment? *

Mark only one oval.

- ◯ Yes
- ◯ No

19. Since the educational intervention 4 weeks ago, do you always follow the CDC guidelines of Oseltamivir for influenza treatment? *

Mark only one oval.

- ◯ Yes
- ◯ No

TABLE OF EVIDENCE

Author, Year	Purpose	Sample & Setting	Methods Design Interventions Measures	Results	Discussion, Interpretation, Limitation of Findings
Apisarnthanarak, A. & Mundy, L. (2008). Antiviral therapy for avian influenza virus (H5N1) infection at 2 Thai medical centers: Survey findings and implications for pandemic preparedness. *Infection Control & Hospital Epidemiology, 29*(12), 1185-1188. http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=105591235&site=ehost-live	Study conducted to evaluate physicians' knowledge and views on two antiviral agents used to treat H5N1.	Physicians working in the ED, pediatrics, intensive care units, and family practice. Setting: Thammasat University Hospital and Pratumthani Hospital in Thailand. Surveys from July to December 2006.	Surveys from 150 physicians. 65-item survey. Evaluated providers' perceptions on antiviral therapy for influenza. Chi-square test or Fisher exact test to compare demographics. Wilcoxon rank sum test used for comparison of continuous variables.	89% of providers completed survey. 60% of providers believed there was a decrease in mortality rates with antiviral use. 40% of providers believed that antivirals could prevent bacterial infections. 25% believed that antivirals reduce symptoms. 10% did not believe in the effectiveness of antivirals.	Need in physician and provider knowledge of when to appropriately prescribe antiviral medications for influenza. Providers should be aware on how to minimize the risk of antiviral resistance by including appropriate diagnostic testing and treatment algorithms into one's practice. Limitations: -Physicians' biased beliefs and practices of influenza treatment.

					-Lack of generalizability due to location. Future Implications: -Evaluating provider prescription habits across the globe. -Inclusion of other healthcare providers (e.g., nurse practitioners).
Bonner, A. B., Monroe, K. W., Talley, L. I., Klasner, A. E., & Kimberlin, D. W. (2003). Impact of the rapid diagnosis of influenza on physician decision-making and patient management in the pediatric emergency department: Results of a randomized, prospective, controlled trials. *Pediatrics, 112*(2), 363-367. http://search.ebscoh	Randomized controlled study performed to determine the impact of rapid influenza diagnostic tests on provider's treatment and plan of care for influenza patients.	Total of 391 patients. Participants' age: 2-months to 21-years old. 241/391 of these patients were aged 2 to 26 months old. Setting: Urban children's hospital ED	Randomized in two different groups. Randomization performed using a program called Rancode. Patients screened for fevers, cough, coryza, myalgias, headaches, malaise. Group 1: Nasopharyngeal swabs collected, tested for influenza A/B with FluOIA; results were placed	202/391 patients tested positive for influenza; 96 of these patients had providers who were aware of the test results; 106 influenza positive patients had physicians who were unaware of the results. Physicians aware of the rapid diagnostic test results had reductions in numbers of other unnecessary	Knowing diagnostic influenza test results can aid in appropriately prescribing an antiviral medication for influenza. Limitations: -Ethics consideration of withholding test results from the providers. -Small sample size. Future Implications: -Focusing on the very young and

ost.com/login.aspx?direct=true&db=ccm&AN=106626937&site=ehost-live			on the chart before patients were seen. Group 2: Nasopharyngeal swabs were collected, stored appropriately, and tested within 24 hours. Results were not given to the provider in this group. Two groups were compared for laboratory tests, charges, prescriptions usage, and length of stay in the ED.	diagnostic tests, antibiotics prescribed, and length of stay in the ED. Group 1 received appropriate antiviral prescriptions.	adult populations. -Generalizable to various practice settings (e.g., primary care).
Chen, R., Fang, Z., & Huang, Y. (2019). Neuropsychiatric events in an adult patient with influenza a (H3N2) treated with oseltamivir (Tamiflu): A case report. *BMC*	Case study explored the adverse events that occurred in an adult treated for influenza A with Oseltamivir.	Study on a 57-years old Chinese female in a general hospital.	Case study on a patient treated for influenza A with Oseltamivir. Patient had influenza-like symptoms 10 days prior to being admitted to the hospital; later	Patient experienced neuropsychiatric symptoms (e.g., hallucinations, delirium) after taking Oseltamivir by day four of its use. Oseltamivir was discontinued and	Neuropsychiatric events can occur in individuals treated with Oseltamivir during or after treatment. Oseltamivir is generally safe to use. Neuropsychiatric

Infectious Diseases, 19(1), N.PAG. https://doi.org/10.1186/s12879-019-3827-4			diagnosed and treated for influenza with Oseltamivir.	symptoms improved.	events are possible. Educate patients and providers on adverse effects (e.g., delirium, hallucinations, and perceptual disturbances). Limitations: -Study focused on one patient. -Low level of evidence. -Population size. -Lack of generalizability due to location. Future Implications: -Inclusion of more individuals with adverse effects due to Oseltamivir use.
Koo, E., McNamara, S., Lansing, B., Olmsted, R. N., Rye, R. A., Fitzgerald, T., & Mody, L. (2016).	Multimodal randomized controlled study performed to evaluate the effectiveness of an educational	Healthcare workers were assessed at 12 nursing homes. Over 200 in-services conducted and included 211 to	Multimodal randomized controlled study. Six nursing homes were in the control group, six nursing homes were the	Control group versus intervention group, pre-test scores were similar (mean difference 1.2%; $p>0.05$).	Goal of study was to improve knowledge pertaining to infection prevention and control with healthcare workers

Making infection prevention education interactive can enhance knowledge and improve outcomes: Results from the Targeted Infection Prevention (TIP) Study. *American Journal of Infection Control, 44*(11), 1241-1246. https://doi.org/10.1016/j.ajic.2016.03.016	intervention in improving healthcare workers knowledge on infection prevention and control.	375 healthcare workers. Setting: Southeast Michigan, U.S.	intervention group. TIP intervention focused on surveillance of MDROs and staff education on infection prevention. Compared pre and post-intervention scores to assess knowledge. 10 educational modules presented. Test scores compared using a 1-tailed paired t-test.	Improvement in post-test scores ($p<0.001$); the intervention was effective.	in a nursing home. Study showed positive impact of an educational intervention. Limitations: -Few studies evaluating effectiveness of educational interventions in nursing home workers. -No post-tests conducted in control group. -High turnover rates with healthcare workers in nursing homes. Future Implications: -Educating individuals tailored to their specific job. -Inclusion of various healthcare settings across the globe.
Linder, J. A., Chan,	Retrospective	Setting: Boston,	Performed	102/535 (~19%)	Goal of the study

J. C., & Bates, D. W. (2006) Appropriateness of antiviral prescribing for influenza in primary care: A retrospective analysis. *Journal of Clinical Pharmacy & Therapeutics, 31*(3), 245-253. http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=106124626&site=ehost-live	analysis performed to evaluate antiviral prescribing for influenza.	U.S. The Brigham and Women's Primary Care (BWPC) Practice Based Research Network (PBRN). Gathered data from nine primary clinics in the greater Boston area. 95 attending physicians and residents. Identified visits with ICD-9 code of influenza made between October 1 and May 31 during the following seasons: 2000-2001 and 2003-2004. Excluded patients < 18 years old and with no corresponding note, duplicate note, or if the visit was made	retrospective analysis of adults diagnosed with influenza or given an electronic antiviral prescription. Sample of 127 visits for acute influenza: 102 visits used billing diagnosis and 25 visits using electronic prescribing. Antiviral prescriptions appropriate if given to patients with symptoms less than 48 hours.	patients diagnosed with influenza. Antivirals given 15/102 (~15%) of the visits; 25 electronic prescriptions for antiviral medication added, totaling to 127 visits and 40 total prescriptions. 28 (70%) of antiviral prescriptions were appropriate. 24% met criteria for antiviral prescribing, but did not receive a prescription. Prescribed more to patients with myalgia (37%; $p=0.04$), and positive influenza test (67%; $p<0.01$).	was to evaluate antiviral prescription usage for influenza in the primary care setting and to determine the reasoning behind inappropriate prescription usage. Need for provider education on appropriate prescription usage of Oseltamivir and other antivirals. Limitations: -Definition of appropriateness was broad. -Small sample size. -Challenges in identifying influenza. Future Implications: -Needs to be clear interventions that target the misuse of antiviral agents. -Inclusion of children in future

		to ED.			studies.
Roosenhoff, R., Reed, V., Kenwright, A., Schutten, M., Boucher, C. A., Monto, A., Clinch, B., Kumar, D., Whitley, R., Nguyen-Van-Tam, J. S., Osterhaus, A. D. M. E., Fouchier, R. A. M., & Fraaij, P. L. A. (2020). Viral kinetics and resistance development in children treated with neuraminidase inhibitors: The influenza resistance information study (IRIS). *Clinical Infectious Diseases, 71*(5), 1186-1194. https://doi.org/10.1093/cid/ciz939	Prospective, non-randomized study performed to evaluate the effect of various components (e.g., age, vaccination status, antiviral therapy, drug resistance) in children affected with influenza A or B.	2,131 children were studied, below the age of 14. IRIS data from 2008 to 2015 was analyzed; multicenter. Participants from U.S., South Africa, China, Europe, and Australia. Inclusion criteria for the first five years: Patients 1-year of age and older (including adults). Mutations were prevalent in children; therefore authors changed inclusion criteria in the last two years to include only children under the age of 14. Exclusion criteria: Participants who	IRIS was a prospective, non-randomized study. Clinical assessments were conducted on days 1, 6, and 10. RT-PCR throat and nasal swabs collected on days 1, 3, 6, and 10. Viral loads summarized in standard deviations and means; viral load, resistance mutations, and influenza subtypes analyzed using regression analysis. Regression analysis shown as confidence intervals (CIs) and odd ratios (ORs) and significance determined by a chi-square test.	683 children positive for H1N1, 825 positive for H3N2, 623 positive for influenza B. 61% of the children received antivirals. Children 10 to 13 years old, with influenza B had higher baseline viral load ($0.05>p>0.01$). These children had a quicker viral clearance compared to younger children. Viral clearance median time was longest for younger children (9.9 to 11.5 days), Children > 5-years old had viral clearance median range of 7.2 to nine days. There is a	Goal of study was to evaluate at-risk populations for influenza and how to appropriately prescribe antiviral medications to the pediatric population. Study showed that children < 5-years old shed 1.04 to 1.24 times more of the influenza virus. Low viral clearance in the younger children may have been due to immature immune responses or lack of prior exposure to influenza viruses. Providers should have an understanding of the findings to appropriately prescribe antivirals for influenza.

		received more than one neuraminidase inhibitor for influenza treatment.		relationship between age and duration of the virus shedding. 185 participants reported adverse events, 117/185 were being treated with antiviral therapy. 14 participants reported serious adverse events, 10/14 were given Oseltamivir. Resistance was higher in children < 5-years of age; those who presented with resistance had higher viral loads at different intervals.	IRIS data analyzed across the globe, leading to generalizability. Limitations: -Inclusion criteria changed after five years. Future Implications: -Consistent study design. -Inclusion of participants of all ages, including adults.
Schauer, S. G., Varney, S. M., Aden, J. K., & Bebarta, V. S. (2016). Patient perceptions of oseltamivir for the treatment of influenza. *Southern*	Cross sectional study performed to determine patient perceptions on Oseltamivir for influenza treatment.	70 surveys collected (67% women, 84% younger than 40 years of age), who presented to the ED with influenza-like symptoms. Adult patients and	Cross sectional, multiple-choice, open response survey (5-point likert scale). Analyzed data using descriptive statistics as frequencies and	70 surveys completed. 31% (p=0.04) of these individuals were < 40-years of age and had seen an Oseltamivir advertisement.	Nearly all patients would deter from Oseltamivir use if they knew the adverse effects. High rates of ED visits are attributed to a lack of

Medical Journal, 109(8), 477-480. https://doi.org/10.14423/SMJ.0000000000000499		pediatric caregivers who presented to the ED for influenza-like symptoms. Study took place during 2014 to 2015 in a rural ED.	percentages. Wilcoxon test used for statistical analysis.	More than 60% of the participants reported positive expectations of Oseltamivir. Most participants believed Oseltamivir was effective for influenza. Most believed great efficacy with Oseltamivir use. Most would not take Oseltamivir if they knew the adverse effects (e.g., renal and liver damage).	understanding of influenza treatments. Need for effective provider and patient communication on Oseltamivir. Limitations: -No reason stated as to why patients refused to participate in the study. -Lack of generalizability. -Gaps in health literacy. Future Implications: -The term "most" was frequently used in the article without numerical values describing what "most" meant. -Need to address how individuals reported such findings.
Van der Vries, E.,	To assess	Adults and children	IRIS data reviewed	3,230 influenza	Antiviral

Ip, D., Cowling, B. J., Zhang, J. D., Tong, X., Wojtowicz, K., … Boucher, C. A. (2016). Outcome and susceptibility to neuraminidase inhibitors in individuals infected with different influenza B lineages: The influenza resistance information study. *Journal of Infectious Diseases, 213*(2), 183-190. https://doi.org/10.1093/infdis/jiv375	susceptibility to antiviral therapy by comparing influenza infections caused by different influenza B virus lineages.	greater than 2-years old, at primary care centers and hospitals who tested positive for influenza or who had influenza-like symptoms for less than or equal to 48 hours. Lineage of influenza B samples reviewed from patients in IRIS between 2009 to 2013 determined by aligned hemagglutinin sequences with reference strains for each lineage. Samples from Australia, Europe, China, and the U.S.	from patients with influenza B. Viruses were sequenced and phenotypically tested to determine virus lineage and neuraminidase inhibitor sensitivity. Patients were assessed on day 1, 6 and 10. Scores were assigned to symptoms. Nasal or throat swabs collected at each visit and self-swabs performed on day 3 using RT-PCR to identify the type of influenza B virus. Day 1,6 and 10 samples with PCR cycle thresholds less than 32 were cultured on Madin-Darby canine kidney cells and	positive patients in IRIS; 914 (28.3%) had influenza B. Of these, 586 were B/Victoria, 289 were B/Yamagata. Mean age of adults from B/Yamagata group: 37.4 years vs. B/Victoria group: 28.2 years. Antiviral treatment was dependent on providers. 473 (52%) patients were treated with antiviral treatment; 440 patients did not receive antiviral treatment. No significant differences between the viral lineages in viral clearance or associated symptoms found in all ages studied.	susceptibility and disease outcomes were not impacted in the different influenza B virus lineages. No differences in the viral loads between the two viral lineages; duration of influenza symptoms and viral positivity were similar. Both influenza B lineages are sensitive to neuraminidase inhibitors. Providers can have an understanding of the different influenza B viral lineages, viral loads, duration of symptoms, viral clearance, and antiviral susceptibility. Influenza treatment

			tested for antiviral susceptibility. Used Kaplan-Meier analysis to compare clinical outcomes between lineages.		was dependent on healthcare providers. Limitations: - Notable differences in ages between the two groups of patients. - Patient allocation was non-randomized; the study investigator determined how to treat patients. Decisions could have been influenced by patient characteristics (e.g., age). Future Implications: -Conducting a similar study with patients of similar ages.

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