4-12-2018

Influenza Vaccine Effectiveness in the Elderly

Sheryl Rudolf

Influenza Vaccine Effectiveness in the Elderly

By

Sheryl Rudolf

A project submitted in partial fulfillment of

Nursing 997

Independent Study

College of Nursing and Professional Disciplines

University of North Dakota

Spring 2018

PERMISSION

Title

Department Nursing

Degree Master of Science

In presenting this independent study in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the College of Nursing of this University shall make it freely available for inspection. I further agree that permission for extensive copying or electronic access for scholarly purposes may be granted by the professor who supervised my independent study work or, in her absence, by the chairperson of the department or the dean of the Graduate School. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my independent study.

Signature Sheryl Ruoff

Date 3-22-18

Abstract

Influenza is a virus that affects people of all ages; and thus, recommendations indicate starting vaccinations: at the age of six months. However, within the population there lies a group of vulnerable people that includes elderly adults. Elderly adults are a population at high risk for poor outcomes related to influenza as they are frailer and have a lower immune response to the influenza vaccination. This paper includes a case report of is on a 56 year old Caucasian man who presented to the clinic with symptoms that were found to be related to influenza. The rapid influenza swab revealed positive influenza and the client was noted to be on methotrexate for his arthritis, which can compromise one's immune system. He was noted to be updated on his influenza vaccination, but over the recommended two days of illness onset to when treatment with anti-viral should be administered. Influenza vaccinations remain an important and effective health measure in helping reduce poor outcomes such as hospitalizations and mortality in elderly adults. Recent research about the effectiveness of influenza vaccinations has been put into question. Frailty and vaccine effectiveness in the elderly were found to have a correlation. This is an important finding as addressing frailty in the elderly has led to the research of using high-dose vaccination to help improve immune responses. Clinicians should take into account frailty and the possibility of using high-dose vaccinations in the elderly to improve their outcomes.

Keywords: Frailty, influenza, vaccination, effectiveness

Influenza Vaccine Effectiveness in the Elderly

Background

Influenza is a communicable illness that can be fatal and lead to significant hospitalizations in vulnerable groups, such as the elderly, pregnant women, and clients with chronic conditions (Lee, Chen, Tang, & Lan, 2014). Most every winter an influenza epidemic occurs, causing about 5 to 20 percent of people to become ill (Lee, Chen, Tang, & Lan, 2014). Illnesses due to influenza lead to approximately 300,000 hospitalizations and 36,000 deaths annually (Lee, Chen, Tang, & Lan, 2014). However, during a pandemic season around 90 percent of deaths occur in people 65 years or older (Lee, Chen, L., Tang, G., & Lan, T, 2014).

In order to avoid the influenza disease and its negative consequences, the main approach for prevention of seasonal outbreaks is vaccinating, making influenza a vaccine-preventable disease (Lee, Chen, Tang, & Lan, 2014). This mainstay approach to prevention is universally recommended for the elderly population, however, evidence to support that vaccinations in the elderly reduce influenza related mortality is insufficient (Simonsen et al., 2007). Many trials indicate that vaccinations help to prevent influenza illness in the young and healthy elderly population. However, no data from studies show benefits for those 70 years and older and this age group accounts for most influenza- related deaths (Simonsen et al., 2007). The efficacy and effectiveness of vaccination for influenza remains uncertain due to this sparse evidence derived from healthy young adults. The evidence for vaccine effectiveness (VE) in frail elderly is even less (Lee, Chen, Tang, & Lan, 2014).

According to Simonsen et al. (2007) effectiveness of the influenza vaccine in elderly nursing home clients actually declines when combined with developing functional impairment. This indicates that frailty could be associated with vaccine-induced antibody responses (Lee, Chen, Tang, & Lan, 2014). It was found that the VE within the elderly especially those 65 years

and older had a large VE gap when confirmed against laboratory influenza results. This range was between 33 to 86 percent and this inconsistency has led to discussion about whether the influenza vaccine benefits elderly people against potential severe outcomes such as hospitalizations or mortality (Lee, Chen, Tang, & Lan, 2014).

Case Report

MA is a 56 year old male who presented to the clinic in January of 2018 with complaints of fever, chills, cough, joint pain and fatigue for past the five days. MA denied being around anyone who was currently sick, and denied any travel out of the country. He stated he had no nausea, vomiting, loss of appetite, or diarrhea. He reported generalized aches and pains. His cough was mostly nonproductive. He denied any hemoptysis or discolored sputum. He had no chest pain and no shortness of breath. He reported the use of ibuprofen 400mg every four to six hours for generalized aches. He reported he did not check his temperature at home but felt the chilled.

Upon evaluation, MA's medical history included rheumatoid arthritis and hypertension. He had no past surgical history and no known allergies. Medications included lisinopril, Humira, Methotrexate injections, and a multivitamin. His social history included no tobacco use and he reported drinking a glass of wine once or twice a week. He was also up to date on his influenza vaccine. Upon physical examination, vital signs included blood pressure 142/92, heart rate 90, respirations 30, and temperature 102.4 degrees Fahrenheit. In general the patient looked unwell, but in no acute distress. Head, ear, eyes, nose and throat exam (HEENT) revealed his head to be atraumatic and normocephalic. Pupils were equal, round, and reactive to light. Extraocular movements were intact. There was no icterus, cyanosis, or pallor of the conjunctivae. His bilateral ear exam including the pinna, tragus, and external canal non-tender. His ear canal and tympanic membranes were translucent and mobile. Nose inspection revealed pink nasal mucosa,

septum midline and patent nares bilaterally. Throat inspection presented an oropharynx with no erythema or exudate. Along with moist mucous membranes, no thrush, no lesions, and good dentition were noted. The neck was supple and trachea was midline. No cervical lymphadenopathy present upon examination. The chest examination revealed adequate air exchange bilaterally, no crackles, wheezes or rhonchi were appreciated. Heart sounds one, and two heard, and no murmurs or gallops present with regular rate and rhythm. No murmurs, gallops, or rubs were noted.

A diagnostic workup included a complete blood count with differential and nasopharyngeal influenza swab. Pertinent laboratory results included a positive rapid influenza antigen test and white blood cell count (WBC) was 9.7. MA was informed that he was positive for influenza; however, he was past the recommended two days of illness onset when treatment with an anti-viral should be administered. He was offered prescription cough syrup with codeine 5mL by mouth three times a day for seven days if needed, given a dose of Tylenol 650mg prior to leaving the clinic, and rechecked temperature upon discharge. The patient was instructed to take Tylenol as needed for aches and pain, to drink many liquids, and stay home and rest. Also the patient was informed to not exceed recommended daily dosage of Tylenol. If he did not get any better, the client was informed to come back to the clinic for further evaluation such as chest x-ray and more lab work. Education on vaccinations was provided because MA is entering the spectrum of old age and has multiple comorbidities, thus it is imperative that he stays up to date on his yearly influenza vaccine. Older adults with multiple chronic medical conditions are at more risk for serious illness and even death.

Literature Review

The body of evidence found for this literature search was broad. Literature found was based on different aspects of evidence including previous studies done on vaccine effectiveness of the elderly, assessment of frailty, and the comparison of vaccine effectiveness for influenza. The interventions and outcomes that were used to measure this search were diverse. Furthermore, none of these studies assessed a placebo-controlled study or randomized control trials, as this would be unethical.

A search strategy was conducted using the University of North Dakota's Harley French medical library. Three different search engines were used in an attempt to search for information and included CINAHL, PubMED, and Clinical Key. The Keywords used were associated with the interventions and included that of *influenza vaccine, elderly* and/or *aged, effectiveness* and *mortality.*

The literature search on the topic of vaccine effectiveness in reducing mortality in the elderly compared to elderly who did not receive the vaccine lead to a wide range of results. Consequently, the articles reviewed had a variety of interventions and means of research. This led to the inclusion of comparing different variations in influenza vaccines, and if one vaccine maybe more beneficial than the other. The consensus was that VE does diminish with increased ageing and that frailty has an astounding effect on VE. Moreover, vaccination still remains an important intervention for influenza, as it is associated with a reduction in hospitalizations and adverse outcomes for the elderly.

An important aspect to account for in the ageing process is frailty. Frailty is considered a measure of health, function, and vulnerability and can predict health outcomes often better than age alone (Andrew et al., 2017; Simonsen et al., 2007). Therefore, frailty is an important

contender that should be addressed when measuring VE. However, in most proposed studies on the influenza vaccine, it is inadequately regarded. (Andrew et al., 2017). Frailty can often be difficult to assess in patient charts as it is calculated by addressing an accumulation of deficits in health using the frailty index (FI). Deficits in health can be signs and symptoms of diseases, disability, and laboratory, electrocardiographic, or radiographic abnormalities. As a patient accumulates more of these deficits, they are more likely to be considered frail. The FI generally is disclosed as a ratio of deficits present compared to the number of deficits considered (Searle, Mitnitski, Gahbauer, Gill, & Rockwood, 2008).

Andrew et al. (2017) performed a case-control study to assess VE in the elderly adult with a focus on frailty. The authors concluded that VE does display differences among non-frail elderly adults and frail older adults in that VE was very good (77.6%) among nonfrail elderly, lower in prefrail elderly, and was all most nonexistent in most frail elderly. This study indicated that frailty assessment is important as it addresses function status in the over-all health status of patients.

Mannino et al.(2012) included an observational study that compared the vaccines MF59 adjuvant trivalent inactivated vaccine (ATIV), versus the nonadjuvanted trivalent inactive vaccine (TIV) in elderly 65 years and older. ATIV was used as a comparison to the standard vacation because it was established for the elderly population to help increase their immune responses to the influenza vaccination. In this study, it was found that the elderly who received ATIV had more baseline hospitalization due to frailty; however, the study still found that those who obtained ATIV had a twenty-five percent risk reduction of hospitalization during peak influenza season than elderly who received TIV.

Similarly, a study done by Domnich, Arata, Amicizia, Puig-Barbera & Gasparini (2017) executed a systematic review of observational studies to find out if using an adjuvant (MF59-TIV) would help to increase vaccine potency; thus allowing, a more rapid and broader immune response in the elderly. These particular authors assessed the adjuvant MF59 which has demonstrated immuno-stimulatory proprietaries such as activating local immune cells at the injection site and promoting transition of monocytes to dendritic cells. This analysis of adjuvants holds value for the elderly as people begin to age; it can consequently cause a reduction in innate and adaptive humoral and T-cell mediated immunity (Andrew et al., 2017). This is a normal process of age-related decline and reduces one's ability to fight off the influenza infection. This process of ageing is known as immunosenescence (Andrew et al., 2017). The authors of this article assessed observational studies, which are great resources to look at vaccine effectiveness in the field, and found that VE with MF59-TIV reduced hospitalizations for pneumonia/influenza by more than 50 percent and is an effective vaccine at reducing influenza related outcomes in the elderly.

In another article by DiazGranados et al. (2014) a high dose vaccine (IIV3-HD) compared to the standard-dose vaccine (IIV3-SD) enhanced antibody responses against influenza in people 65 years or older. They found similar results in that a higher dose vaccine did in fact provide enhanced protection against confirmed influenza illness.

The theory of high dose vaccination holds value in another study by Nace et al. (2015) who found that in the frail elderly, high dose vaccination produced higher-level responses for almost every strain of influenza. In this literature search, this was the only study found that performed a randomized control trial (RCT) within long-term care facilities on clients 65 years or older. The study compared standard dose influenza vaccines versus high dose vaccinations. In

order to compare the two vaccines blood samples were obtained and analyses of geometric mean titers (GMT) were used as the outcome. Using this means, the study found that in frail older adults the GMT's were higher with the high dose vaccination indicating an enhanced immune response.

In an additional study by Wilkinson et al. (2017), a systematic review was conducted to determine whether higher-dose vaccines of influenza were more effective and usage was safe in the elderly aged 65 years or older. Their theory was that elderly are more pressured to receive the influenza vaccine to help reduce poor outcomes; however, they are prone to having lower antibody reaction to vaccines rendering them less effective. Thus, raising the dose of influenza antigens may increase their immune response and enable the vaccine to be more effective. The outcome addressed in this study did not look at reduction in mortality, but rather a reduction in laboratory-confirmed illness. When addressing this outcome, it was found that the elderly whom received a high-dose influenza vaccine had a 24 percent reduction in the risk of laboratory-confirmed influenza compared to those who received the standard-dose vaccine. The evidence that high-dose vaccinations are effective at reducing the amount of influenza cases is paramount as a study by Jefferson et al. (2005), whom performed a search of electronic databases, found that VE of trivalent influenza vaccines had a minimal effect on the reduction of cases within the elderly population. Nevertheless, the standard dose of the influenza vaccination proved to have a better impact on complications of influenza such as hospitalizations and all-cause mortality rather than cases of influenza.

Thomas (2014) who also performed a systematic review found the outcome of mortality often was an all-cause mortality, which is a non-specific outcome and can be subject to unknown biases. He concluded that specific outcomes would be more applicable if they included

laboratory-proven influenza or pneumonia deaths. Moreover, the author found that influenza associated death for those greater than 80 years of age was 11 times higher than the elderly ages 65-69 and that these numbers continued to remain true even with increasing vaccination rates and vaccine match. In this randomized control study, the author found evidence that vaccine efficacy does in fact decrease with increasing age.

Campitelli, Rosealla, Stukel & Kwong (2011) conducted a cohort study to estimate the effectiveness of influenza vaccines in the elderly and whether it helps to reduce all-cause mortality. These authors wrapped up this literature search with the convincing evidence that elderly who receive an influenza vaccine are 39 percent less likely to die from any cause during influenza season when compared to non-vaccinated elderly. In addition to this evidence, they discovered that vaccinated individuals were also 45 percent less likely to die during pre-influenza season and 26 percent less likely to die during post-influenza season. This indicates that not only does the influenza vaccine help reduce mortality, but it also has the presence of residual confounding effects during times when the influenza virus is not circulating.

Throughout this search, there was one article which found that biases do exist within research studies and do affect outcomes within the elderly. An article by Wong, Campitelli, Stukel, & Kwong (2012) whom performed a cohort study over nine influenza seasons used instrumental variable (IV) analysis. IV analysis is a method of analysis that has been found to remove hidden bias in observational studies. This study using logistic regression found that adults 65 years and older who received an influenza vaccination demonstrated a reduction in both hospitalizations and mortality (33%) during influenza season and significant reduction in mortality after influenza season. However, when using IV analysis, which adjusted the association of influenza vaccination mortality during the influenza season, analysis expressed no

significance between the two seasons. These results also held true of IV analysis of post-influenza vaccination.

Through this research it confirmed that with age comes a decrease in vaccine effectiveness ranging from 17 to 60 percent, and that biases do exist within the research of VE in the elderly (Nace et al., 2015). Influenza combined with pneumonia ranks as the eighth leading cause of death and is the number one vaccine preventable death in the United States. A goal of Healthy People 2010 is to have residents in long term care facilities reach an immunization goal of 90 percent for both influenza and pneumonia (Nace et al., 2015). This is imperative for the elderly and especially those in long-term care facilities as they are more exposed to the influenza virus, have reduced immune responses, and increased mortality rates compared to other populations (Nace et al., 2015). An important indicator to help assess if one is in need of a vaccination, especially a high-dose vaccination, is frailty and most often this incompletely captured in the health record. Frailty is an important confounder to address when assessing VE in the elderly as a lack of assessment can lead to underestimating VE in this specific population (Nace et al., 2015). In addition, if frailty assessment is overlooked for this population it can be considered frailty bias. The value of the influenza vaccination remains high as vaccinations for this particular age have been shown to reduce poor outcomes and proven to be the most cost effective health measure in reduction of the influenza virus.

Learning Points

- The best way to accomplish the Healthy People goal, as proven by presented research is with the use of high-dose vaccines to help produce a stronger immune response in the elderly.

- Assessment of frailty is important as the impact of influenza VE varies from very good in a healthy adult to almost nonexistent in the frail elderly (Nace et al., 2015).
- Interventions for providers to help improve rates of vaccination include the use of reminders for patients; such as, reminder postcards or a phone call. To help increase access to influenza vaccinations providers and clinics could promote group visits or make home visits.
- A second option could be to place facilitators in clinics alongside health professionals to help with education about influenza and influenza vaccinations to the patients and their caregivers (Thomas, Russel & Lorenzetti, 2010)..

Reference

Andrew, M. K., Shinde, V., Lingyun, Y., Hatchette, T., Haguinet, F., Dos Santos, G., & ... Loeb, M. (2017). The importance of frailty in the assessment of influenza vaccine effectiveness against influenza-related hospitalization in elderly people. *Journal of Infectious Diseases, 216*(4), 405-414. doi:10.1093/infdis/jix282

Campitelli, A., M, Rosell, C., L, Stukel, A., T, Kwong, C., J. (2011). Influenza vaccination and all-cause mortality in community-dwelling elderly in ontario, canada, a cohort study. *Vaccine, 29,* 240-246. doi:10.1016/j.vaccine.2010.10.049

DiazGranados, C. A., Dunning, A. J., Kimmel, M., Kirby, D., Treanor, J., Collins, A., & ... Talbot, H. K. (2014). Efficacy of high-dose versus standard-dose influenza vaccine in older adults. *New England Journal of Medicine, 371*(7), 635-645. doi:10.1056/NEJMoa1315727

Domnich, A, Arata, L, Amicizia, D, Puig-Barbera, J, Gasparini, R. (2017). Effectiveness of MF59-adjuvanted seasonal influenza vaccine in the elderly: A systematic review and meta-analysis. *Vaccine, 35*(4), 513-520. doi: 10.1016/j.vaccine.2016.12.011

Jefferson, T., Rivetti, D., Rivetti, A., Rudin, M., Di Pietrantonj, C., & Demicheli, V. (2005). Efficacy and effectiveness of influenza vaccines in elderly people: A systematic review. *Lancet (London, England), 366*(9492), 1165-1174.

Lee, W., Chen, L., Tang, G., & Lan, T. (2014). The impact of influenza vaccination on hospitalizations and mortality among frail older people. *Journal of The American Medical Directors Association, 15*(4), 256-260. doi:10.1016/j.jamda.2013.12.003

Mannino, S., Villa, M., Apolone, G., Weiss, N. S., Groth, N., Aquino, I., & ... Rothman, K. J. (2012). Effectiveness of adjuvanted influenza vaccination in elderly subjects in

northern italy. *American Journal of Epidemiology, 176*(6), 527-533. doi:10.1093/aje/kws313

Nace, D. A., Lin, C. J., Ross, T. M., Saracco, S., Churilla, R. M., & Zimmerman, R. K. (2015). Randomized, controlled trial of high-dose influenza vaccine among frail residents of long-term care facilities. *Journal of Infectious Diseases, 211*(12), 1915-1924. doi:10.1093/infdis/jiu622

Nace, D. A., Perera, S., Handler, S. M., Muder, R., & Hoffman, E. L. (2011). Increasing influenza and pneumococcal immunization rates in a nursing home network. *Journal of the American Medical Directors Association, 12*(9), 678-684. doi:10.1016/j.jamda.2010.05.002

Searle, D. S., Mitnitski, A., Gahbauer, A. E., Gill, M. T., & Rockwood, K. (2008). A standard procedure for creating a frailty index. BMC Geriatrics 8(24). doi:10.1186/1471-2318-8-24

Simonsen, L., Taylor, J. R., Vibound, C., Miller, A. M., & Jackson, A. L. (2007). Mortality benefits of influenza vaccination in elderly people: An ongoing controversy. Lancet Infectious Disease, 7, 658-666. doi:10.1016/S0140-6736(07)61389-0

Thomas, E. R. (2014). Are influenza-associated morbidity and mortality estimates for those >65 in statistical databases accurate, and an appropriate test of influenza vaccine effectiveness? *Vaccine, 32*(51), 6884-6901. doi: 10.1016/j.vaccine.2014.08.090

Thomas, E. R., Russel, L M., Lorenzetti, L. D. (2010). Systematic review of intervention to increase influenza vaccination rates of those 60 years and older. *Vaccine 28,*1684-1701. doi:10.1016/j.vaccine.2009.11.067

Wilkinson, K., Wei, Y., Szwajcer, A., Rabbani, R., Zarychanski, R., Abou-Setta, M. A., & Mahmud, M. S. (2017). Efficacy and safety of high-dose influenza vaccine in the elderly adults: A systematic review and meta-analysis. *Vaccine, 35*(21), 2775-2780. doi: 10.1016/j.vaccine.2017.03.092.

Wong, K., Campitelli, M., Stukel, T., & Kwong, J. (2012). Estimating influenza vaccine effectiveness in community-dwelling elderly patients using the instrumental variable analysis method. *Archives of Internal Medicine, 172*(6), 484-491.