

Vaccination Status, Knowledge, Attitude and Perceptions of Vaccination against Influenza and Pneumococcal Pneumonia in Diabetic Population of Lahore, Pakistan



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Abstract

Background: Diabetes is a clinical condition predisposing individuals to a higher risk of infection. Vaccination can reduce susceptibility to infections. Unfortunately, robust data on the vaccination status of our population with diabetes is lacking though we stand as a country with the third highest cases of diabetes worldwide. Therefore, we intend to identify the vaccination status of our diabetic population and assess people's awareness and attitude toward vaccination against influenza and Pneumonia.

Methods: This was a cross-sectional survey in which patients with diabetes were asked for relevant information as per a pre-defined questionnaire. The statistical analysis was done using SPSS 22.0 version.

Results: We enrolled 526 patients; the mean age was 58 years (SD±10.9). The majority of participants were females 68 % (362/526), and 52% (274/526) were aware of being increasingly susceptible to influenza and pneumonia. Only 12 % (64/526) were vaccinated against influenza over the last 5 years and 7% (36/526) against pneumococcus. More males were vaccinated against influenza than females and this result was statistically significant (p-value < 0.001). Influenza and pneumococcal vaccination were more common among the more affluent and more educated individuals this comparison was statistically significant (p-value < 0.001). A significant proportion of unvaccinated (374/460, 81%) showed a willingness to get vaccinated.

Conclusion: The uptake of annual influenza every autumn, and one-off pneumococcal vaccines among diabetics in our region is very low. The importance of vaccination needs to be generated through effective awareness campaigns as people with diabetes showed keen interest in receiving relevant vaccination.

Keywords: Vaccination, influenza, pneumococcal, diabetes, Pakistan

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Introduction

Diabetes mellitus (DM) is one of the global foremost causes of death. International Diabetes Federation (IDF), in Diabetes Atlas 10th Edition, reported 6.7 million deaths due to diabetes in the year 2021. Worldwide Over half a billion people are living with this disease and the number is expected to increase to 643 million by 2030 and 783 million by 2045(1). IDF also reports that the prevalence of diabetes in Pakistan has shown a 70% increase since 2019 and in 2021, 33 million adults in Pakistan were living with diabetes (2). Diabetes increases the risk of life-threatening complications, particularly, susceptibility to infections and complications of influenza and pneumococcal pneumonia (3-6). Pakistan, a developing country with scarce resources and a huge burden of diabetics, is faced with a challenging situation in the winter season with multiplied influenza and pneumonia cases.

Timely, appropriate vaccination of people with diabetes can control the morbidity and mortality associated with such illnesses and their burden on

struggling healthcare services. However, a national vaccination policy against influenza as such ceases to exist in Pakistan which is evident by the unsuccessful planning and implementation of anti-influenza coverage programs (7). Moreover, the main focus has been on childhood immunization and Expanded Program on Immunization (EPI) in Pakistan, with very few studies done on adult immunization coverage(8). There are significant deficiencies in the available information regarding community-acquired pneumonia in Pakistan(9-11). One study regarding adult vaccination status in Pakistan published in Karachi showed that only 36% of enrolled received any vaccine in adulthood and the chief reason given for not receiving vaccines was lack of awareness (62%)(12). Similar results were obtained in our study done among the elderly(13). These studies highlight the dire need to address this major preventive strategy. Influenza is a transmissible, acute respiratory illness caused by the influenza virus, usually influenza A or B subtypes while Pneumococcal Pneumonia caused by the bacterium *Streptococcus Pneumoniae* is a form of acute respiratory infection that affects the lungs.

According to World Health Organization (WHO) estimates, globally annual influenza epidemics result in about 3-5 million cases of severe illness and about 250,000 to 500,000 deaths (14). According to Centers for Disease Control and Prevention (CDC) 24,000 to 62,000 deaths were attributed to seasonal influenza during the 2019-2020 season and 5,000 to 14,000 deaths have been estimated from October 2021 to June 2022(15). Meagre information is available on the extent of pneumococcal disease in developing countries but available literature does show an increase in reports of incidence, prevalence, and complications in many areas of Europe, Asia, and Australia (16).

Anyone can get sick with the flu but people 65 years and older, people of any age with certain chronic medical conditions (like asthma, diabetes, or heart disease), and pregnant women are at a high risk of developing serious complications. Pneumococcal pneumonia is the most common clinical presentation of pneumococcal disease in adults. CDC recommends pneumococcal vaccination for adults 19 through 64 years old who have certain medical conditions such as diabetes mellitus or who smoke and all adults 65 years or older (17).

Cardiovascular (CV) events are common among adults hospitalized with seasonal influenza, but vaccination lowers the risk, according to an Annals of Internal Medicine study (18) Research has shown that as compared to people without diabetes those with diabetes are 3–6 times more likely to be hospitalized with influenza complications and even their death rate rises by 5–15 percent during influenza epidemics (19). Older patients and those with preexisting CV conditions and known risk factors were at greater risk for acute disease as shown by the study done by Goeijenbier M and colleagues (19). Diabetics with influenza are potentially at a greater risk of developing CV complications as both factors may contribute independently or cumulatively towards a poor outcome.

Vaccination has been shown to reduce the risk of getting sick with the flu and having a serious flu outcome like staying in the hospitals or being admitted to the intensive care units which are excessively overburdened in the flu season (20,21). It is therefore of paramount importance for developing countries like Pakistan, with healthcare restraints, to implement effective preventive strategies for a more cost-effective and sustainable approach to managing growing healthcare problems.

Keeping in mind the importance of vaccination among diabetics, our research project aimed to assess the status of vaccination among the people with diabetes in our population and identify the knowledge, attitude, and perceptions regarding vaccination in our setup at this point. Vaccines against Influenza and Pneumococcus are generally available in large cities of Pakistan like Lahore. Our study aimed to identify any factors influencing vaccination uptake as identified in other regions of the world (22,23).

Methodology

Study Design and Setting

The study is a cross-sectional survey conducted at Combined Military Hospital (CMH) Lahore and includes diabetics in the community. This hospital caters to patients of mixed socioeconomic backgrounds and provides healthcare facilities to military officers, soldiers their families, and civilians.

Inclusion and Exclusion Criteria

All type 1 and 2 diabetics 18 years or above, irrespective of gender and race, presenting to the Medical Outdoor and admitted to the In-patient Department at CMH Lahore plus Diabetics in Lahore outside of CMH, who matched the inclusion criteria were enrolled and interviewed. Diabetics below 18 years, those who did not give consent or had a history of allergic reactions to vaccines were excluded.

Data Collection

The study was approved by the Ethical Committee of CMH, (case#477/ERC/CMH/LMC). This was followed by data collection over a period of 3 months from August to October 2020. This time frame had the benefit of creating awareness regarding vaccination among diabetics right before the flu season so they could get their shots in time. Patients fulfilling the inclusion criteria were identified and explained the purpose of the research in their native language. Verbal and written consent was then taken from the patients. Questionnaires (pre-tested) were filled exactly as answered by the patients. Questions were asked in the local language of the patient and the investigator assisted in filling in the response.

Statistical Analysis

A sample size minimum of 218 diabetics was calculated with a precise error of 5% & confidence interval of 95% (24). The prevalence of diabetes in Pakistan was taken as 17.1% according to IDF 2019 figures. To improve the precision of our results we included 526 participants in our study. The statistical analysis was done using SPSS 22.0 version. Continuous variables like age were expressed as mean± SD. Categorical variables like gender were expressed as frequencies and percentages. The Chi-square test was applied to compare the categorical outcomes and a p-value <0.05 was considered significant.

Results

Our study included a total of 526 patients. The mean age was 58 years (SD±10.9). The majority of participants were females (68%), married (83%), and belonged to an urban setting (76%) whereas diversity was evident in the education and socioeconomic status of these individuals as shown in Table 1.

Table 1. Demographic Profile of Study Population (N=526).

Parameters	Number (%)
Gender	
Male	164 (31)
Female	362 (68)
Marital status	
Single	14 (3)
Married	438 (83)
Other	74 (14)
Income (Pak rupees)	
10,000-24,000	16 (3)
25,000-49,000	102 (19)
50,000-99,000	196 (37)
≥100,000	212 (40)
Education	
Illiterate	106 (20)
Below matric	94 (18)
Matric	94 (18)
Intermediate	112 (21)
Graduate	72 (14)
Post-graduate	48 (9)
Region	
Urban	400 (76)
Rural	126 (24)
Type of Diabetes	
Type-1	18 (3)
Type-2	508 (97)

The study assessed the knowledge and perceptions regarding influenza and pneumococcal vaccination among diabetics, the majority of whom had Type II DM (96.6%). Regarding the previous history of influenza/pneumonia, just over half the population (268/526, 51%) had previously experienced flu-like symptoms/ bad chest. Nearly the same number (274/526, 52%) were aware of being increasingly susceptible to influenza/pneumonia as a result of being diabetic. A significant proportion of the individuals (488/526, 92.8%) were unaware of the complications of these illnesses.

Regarding the vaccination status, the results showed that only a small percentage (64/526, 12 %) of diabetic were as vaccinated against influenza over the last 5 years. Of these, the majority were vaccinated only once in the last 5 years, as shown in fig-1. An even smaller number were vaccinated against pneumococcus (36/526, 7%).

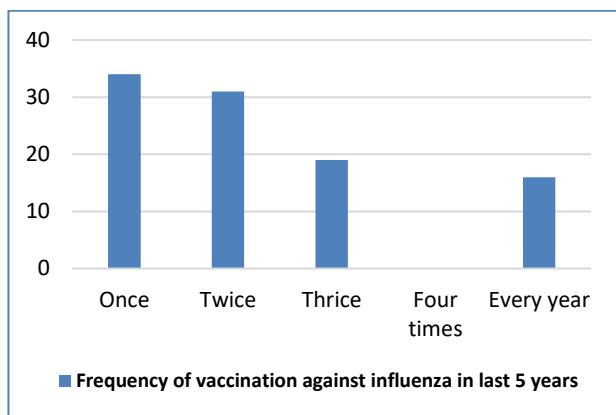


Figure 1: Frequency of vaccination against influenza in last 5 years.

Among those who were aware of these vaccines, the maximum number (86/122, 70.5%) had gathered information about them from their doctors. On the other hand, the least number of individuals (2/122, 2%) reported television as a source of information about vaccines, as is evident in fig-2.

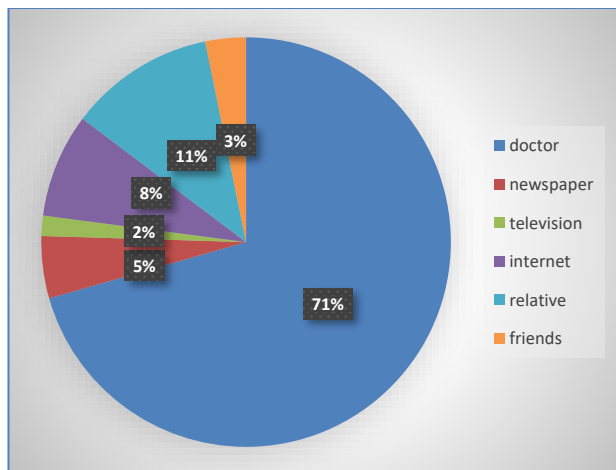


Figure 2: Source of information about vaccination.

Furthermore, the results showed that a significant

proportion of diabetics (424/526, 81%) were aware of the benefits of vaccination. When asked about their perception regarding the efficacy of vaccines, most participants (312/526, 59%) believed vaccines prevent disease while some others (88/526, 17%) believed that vaccines reduce susceptibility to their respective illnesses. None believed vaccines to be a cure for the disease.

Of the male population in the study (164/526, 31%), about a quarter (40/164, 24%) were vaccinated against influenza while even lesser numbers (18/164, 11%) were vaccinated against pneumococcus. A greater proportion of subjects in the study were females (362/526, 69%). Of these, a very small number (24/362, 7%) were vaccinated against influenza and even fewer (18/362, 5%) against pneumococcus. More males were vaccinated against influenza than females and this result was statistically significant (p-value < 0.001). Similarly, more males were vaccinated against pneumococcus than females (p-value 0.06).

Considering the socioeconomic status of the subjects, it was seen that 40% (212/526) belonged to an income group of Rs. 100,000 or above. Out of these 25% (52/212) were vaccinated against influenza and 14% (30/212) were vaccinated against pneumococcal. Among those with income below Rs 100,000, who were 60% (314/526) of the total study group, 4% (12/314) were vaccinated against influenza and only 2% (6/314) against pneumococcus. Therefore, it was evident that influenza and pneumococcal vaccination were more common among the more affluent individuals and this comparison was statistically significant (p-value < 0.001). Concerning the education status, 44% (232/526) participants were educated up to the intermediate level or higher, while 56% (294/526) were educated below the intermediate level. Amongst those educated up to intermediate level or higher, more were vaccinated against influenza; 25% (58/232), as compared to 13% (30/232) vaccinated against pneumococcus. As for those educated below the intermediate level, vaccination against influenza was the same as pneumococcus; 2% (6/294) each. Overall, it was seen that the higher-educated individuals were more readily vaccinated and this relationship between education and vaccination status was statistically significant (p-value < 0.001).

Comparing the impact of geographical location, the results showed that 14% (56/400) of urban residents were vaccinated against influenza as opposed to only 6% (8/126) of rural residents. However, this comparison was not statistically significant (p-value 0.07). Similarly, 8% (32/400) of urban citizens were vaccinated against pneumococcus while only 3% (4/126) of rural citizens were vaccinated, but this too was a statistically insignificant result (p-value 0.14).

The study included both Type 1 diabetics; 3% (18/526) and Type 2 diabetics; 97% 508/526. Of these, 22% (4/18) of Type 1 diabetics were vaccinated against influenza as opposed to 12% (60/508) of type 2 diabetics. On the other hand, 7% (36/508) of type 2 diabetics were vaccinated against pneumococcus but none of Type 1.

Amongst those participants who had one or both vaccines (66/526, 12.5%) the majority (58/66, 8%) were willing to get vaccinated as per the advice of their doctor, as shown in figure 3.

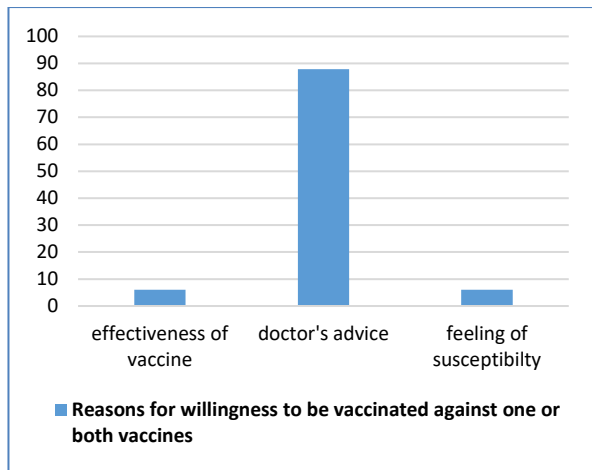


Figure 3: Reasons for willingness to get vaccinated.

Of the large proportion of individuals who were not vaccinated with any vaccine at all (460/526, 87.5%), majority (260/460, 56.5%) reported a lack of awareness as the reason for not being vaccinated, as presented in figure 4.

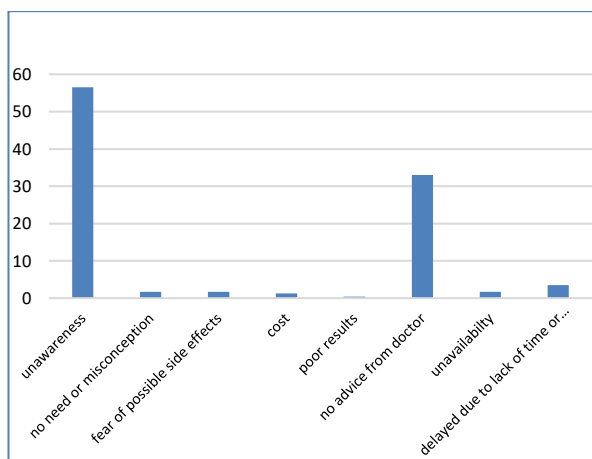


Figure 4: Reasons for lack of vaccination against influenza and pneumococcal vaccines.

Discussion

Most people are aware of childhood vaccination due to the successful implementation of EPI on a national scale, on the other hand, the awareness and coverage of adult vaccination, especially amongst diabetics, is quite low in our country. A total of 526 diabetic subjects were enrolled in our study out of which an alarmingly low number of 64 persons (12%) had been vaccinated against influenza, pneumococcal, or both. Unfortunately, there is no local data on the vaccination status of diabetics available for comparison. Similar results were seen in a study regarding the vaccination status of diabetics conducted in our neighboring country, the state of Jammu and Kashmir northern part of India with influenza and Pneumococcal vaccination rates of 9% and 8.8% respectively (25). In contrast to these figures, the influenza vaccination coverage of some Middle Eastern and European countries was significantly better; Saudi Arabia 61% (26) Spain 65% (27) and Turkey 63% (28).

Our study revealed that the most common reason for the low vaccination rate among our diabetics was the lack of awareness regarding vaccination, with no advice from the doctor being the second most common response. On the other hand, the majority of those who had been vaccinated, although quite a few, had done so based on their doctor's advice. In contrast to this, media advertisement in the form of television, newspaper, or the internet, was not a very effective means of creating vaccination awareness. These results are in concordance with research conducted in Saudi Arabia and South Africa (26,29) that revealed that the healthcare providers' advice had a powerful impact in motivating T2DM participants for vaccination while media advice was the least motivating factor. The eager interest of the government and public regarding the prevention of such diseases and the easy accessibility to the vaccine in these countries were potential reasons for the better seasonal influenza coverage in comparison to other parts of the world.

In the more developed countries, the reasons for the lack of vaccination were different. For instance, in Europe, the barrier towards immunization was reported to be avoidance of vaccination rather than lack of awareness. One study conducted in Spain showed that there was a belief among patients as well as healthcare providers that vaccines are not effective or cause significant harmful effects that kept them from getting vaccinated (30).

The above discussion shows the need of creating awareness amongst the masses regarding the importance of vaccination for diabetics. It also highlights the tremendous role that doctors play in educating their patients. They are not only the most common source of healthcare information for their patients but also the most effective means of convincing them of strategies that are most beneficial to them. People with diabetes are at great risk of developing serious complications of influenza and pneumonia, especially in the winter season so it is crucial to educate them about the benefits of timely vaccination. As reported in a systematic literature review by Dos Santos G, Tahrat H, and Bekkat-Berkani R (31), the immunogenicity of seasonal influenza vaccination in patients with diabetes was substantially comparable to that of healthy participants. Seroprotection one month after vaccination ranged from 29.0–99.0% among diabetics. This reduced the chances of hospitalization and mortality in such patients, particularly those aged ≥ 65 years. This provides proof of the worth of seasonal influenza vaccination in diabetic patients. Our study showed that most of the participants were vaccinated only once in the last 5 years as opposed to the need for annual influenza vaccination. Moreover, raising public awareness on this subject by improving the deficiencies in social media advertisements to deliver a clear educational message about influenza and pneumococcal vaccination might prove equally beneficial. We observed that among those who were not vaccinated with either, a significant proportion 81% (374/460) showed a willingness to get vaccinated once they were counseled. This was reassuring. Contrary to this very low figure of willingness, 19.55% (342/1749) of the participants have as been reported from southeast China (32).

Another important finding of our study was that influenza vaccination and awareness is more common than

pneumococcal, with only a minor number of diabetics 7% (36/526) vaccinated against pneumococcus. Therefore, extra attention needs to be paid to encouraging the use of this beneficial vaccine, especially in elderly diabetics.

WHO report of 2018 indicates that 118 of its 194 member States have influenza vaccination policies. Among low and low-middle-income countries, representing 40% of the world's population, out of 61 countries, 52 (85%) countries had no such policy (33). Although influenza vaccination policies do not guarantee equitable access or ensure vaccination coverage, they are vital to establishing a cohesive influenza vaccination program, which can reduce morbidity and mortality associated with annual influenza, especially in high-risk groups. Such programs can also provide a good foundation for pandemic preparedness and response. We have witnessed and experienced, how resources had to be mobilized towards COVID-19 pandemic management globally, at the cost of compromising other major health issues.

Recommendations:

We recommend that appropriate strategies be adopted by both the public and private sectors for this purpose. Health advocacy requires effective awareness campaigns, especially in rural areas where vaccination rates are quite low compared to urban areas, and social media is not readily accessible. Public service messages can be delivered through television, radio, internet, and telephonic means to create widespread awareness on a national level. Furthermore, great weightage is given by the public to doctors' advice. Doctor-patient discussion on this subject is a worthwhile and cost-effective means to promote vaccination in high-risk groups such as diabetics in clinics and hospitals. In addition, there is a need to address the availability of vaccines so that efforts to create awareness can translate into significant preventative outcomes. Therefore, we recommend that further studies be done to assess the availability of vaccines in our country.

Limitations:

Our study has a limited sample size which may not be representative of the entire population thus limiting the generalization of results. Also, very limited data is published in this respect and we expect the true figures to be far lower. Furthermore, our study does not assess the availability of vaccines in our region. Addressing the lack of awareness regarding vaccination would only be fruitful if it's met with an affordable and readily accessible supply of vaccines.

Conclusion

The uptake of annual influenza every autumn and one-off pneumococcal vaccines among diabetics in our country is very low. People who have diabetes are at a greater risk of developing grave complications of influenza and pneumonia. Pakistan harbors the 3rd highest population of patients with diabetes so it is crucial to educate them about the benefits of timely vaccination.

References

- International Diabetes Federation. IDF Diabetes Atlas, 10th edition. Brussels, Belgium: International Diabetes Federation, 2021.
- Sun H, Saeedi P, Karuranga S, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*. 2022 Jan; 183:109119. DOI: 10.1016/j.diabetes.2021.109119. PMID: 34879977.
- Shashank RJ, Samika SJ, Siddharth NS. Pneumococcal Vaccine in Diabetes: Relevance in India. *J Assoc Physicians India*. 2015 Apr; 63(4 Suppl):34-5.
- National Center for Immunization and Respiratory Diseases (NCIRD). (2019). Flu and People with Diabetes. <https://www.cdc.gov/flu/highrisk/diabetes.htm>
- Muller LMAJ, Gorter KJ, Hak E, et al. Increased risk of common infections in patients with type 1 and type 2 diabetes mellitus. *Clin Infect Dis*. 2008; 41:281-8.
- S. Thomas, A. Ouhitit, H.A. Al-Khatib et al Burden and disease pathogenesis of influenza and other respiratory viruses in diabetic patients. *Journal of Infection and Public Health* 15 (2022) 412-424.
- Ahmed, A., Saqlain, M., Tanveer, M., & Ali, H. (2019). Critical analysis on influenza status in Pakistan: Current Polices, Challenges and Recommendations *Pakistan Journal of Public Health*, 9(1), 01-03.
- Butt M, Mohammed R, Butt E, Butt S, Xiang J. Why Have Immunization Efforts in Pakistan Failed to Achieve Global Standards of Vaccination Uptake and Infectious Disease Control? *Risk Manag Healthc Policy*. 2020 Feb 12; 13:111-124. doi: 10.2147/RMHP.S211170. PMID: 32104117; PMCID: PMC7024803.
- Hasan, S., Webby, R.J., Iqbal, M. et al. Sentinel surveillance for influenza A viruses in Lahore District Pakistan in flu season 2015-2016. *BMC Infect Dis* 22, 38 (2022).
- Ansarie M, Kasmani A. Community acquired pneumonia in Pakistan: an analysis on the literature published between 2003 and 2013. *J Pak Med Assoc*. 2014 Dec;64(12):1405-9. PMID: 25842587
- Nisar N, Aamir UB, Badar N, Mahmood MR, Yaqoob A, Tripathy JP, Laxmeshwar C, Tenzin K, Zaidi SS, Salman M, Ikram A. Epidemiology of Influenza among patients with influenza-like illness and severe acute respiratory illness in Pakistan: a 10-year surveillance study 2008-17. *Journal of Medical Virology*. 2020 Dec; 92(12):3028-37.
- Zaki S, Usman A, Tariq S, Shah S, Azam I, Qidwai W, Nanji K. Frequency and Factors Associated with Adult Immunization in Patients Visiting Family Medicine Clinics at a Tertiary Care Hospital, Karachi. *Cureus*. 2018 Jan 17;10(1): e2083. doi: 10.7759/cureus.2083. PMID: 29560296; PMCID: PMC5856407.
- Kitchlew R, Shamim A, Kakalia S, Khan A, Latif S, Perception and Vaccination Status of Elderly Individuals Aged 60 years and Above: An Urban Lahore Analysis. *Proceedings S.Z.M.C. Vol: 36(3): pp. 36-42, 2022.*
- World Health Organization. Global Influenza Strategy 2019-2030. Available at https://www.who.int/influenza/Global_Influenza_Strategy_2019_2030_Summary_English.pdf.
- 2021-2022 U.S. Flu Season: Preliminary Burden Estimates. Centres for Disease Control and Prevention. Available at <https://www.cdc.gov/flu/about/burden/preliminary-in-season-estimates.htm>. 2022 Jun 17.
- Aston SJ. Pneumonia in the developing world: Characteristic features and approach to management. *Respirology*. 2017 Oct;22(7):1276-1287. doi: 10.1111/resp.13112. Epub 2017 Jul 6. PMID: 28681972.
- CDC Expert Commentary on Medscape: 5 Things to Know About Pneumococcal Disease and the New Adult Pneumococcal Vaccine Recommendations, Miwako Kobayashi, DISCLOSURES February 17, 2022
- Modin D, Claggett B, Køber L, et al. Influenza Vaccination Is Associated with Reduced Cardiovascular Mortality in Adults With Diabetes: A Nationwide Cohort Study. *Diabetes Care*. 2020 Sep;43(9):2226-2233. DOI: 10.2337/dc20-0229. PMID: 32647052.
- Chow EJ, Rolfes MA, O'Halloran A, Anderson EJ, et al. Acute Cardiovascular Events Associated with Influenza in Hospitalized Adults: A Cross-sectional Study. *Ann Intern Med*. 2020 Oct 20;173(8):605-613. doi: 10.7326/M20-1509. Epub 2020 Aug 25. PMID: 32833488; PMCID: PMC8097760.
- Goeijenbier M, Van Sloten TT, Slobbe L, Mathieu C, Van Genderen P, Beyer Walter EP, Osterhaus ADME: Benefits of flu vaccination for persons with diabetes mellitus: a review. *Vaccine*, 2017; 35(38):5095-101.
- Mark W Tenforde, H Keipp Talbot, Christopher H Trabue, Manjusha Gaglani et al Influenza Vaccine Effectiveness Against Hospitalization in the United States, 2019-2020, *The Journal of Infectious Diseases*, Volume 224, Issue 5, 1 September 2021, Pages 813-820.
- Gorska-Ciebiada M, Saryusz-Wolska M, Ciebiada M, Loba. Pneumococcal and seasonal influenza vaccination among elderly patients with diabetes: *J. Postepy Hig Med Dosw (Online)*. 2015; 28:6.

23. Verger P, Bocquier A, Vergélys C, Ward J, et al: Flu vaccination among patients with diabetes: motives, perceptions, trust, and risk culture - A qualitative survey. *BMC Public Health*, 2018; 18:569.
24. Charan J, Biswas T. How to Calculate Sample Size for Different Study Designs in Medical Research? *Indian J Psychol Med*. 2013 Apr-Jun; 35(2):121–126.
25. P.A. Koul, M.A. Bhat, S. Ali, et al. Influenza and Pneumococcal vaccination in patients with diabetes. *Journal of Diabetology*, June 2014; :5. <http://www.journalofdiabetology.org>
26. Alnaheelah IM, Awadalla NJ, Al-Musa KM, Alsabaani AA, Mahfouz AA. Influenza Vaccination in Type 2 Diabetes Patients: Coverage Status and Its Determinants in Southwestern Saudi Arabia. *Int J Environ Res Public Health*. 2018 Jul 1;15(7):1381. doi: 10.3390/ijerph15071381. PMID: 29966382; PMCID: PMC6068768.
27. Jimenez-Trujillo I, López-de Andrés A, Hernández-Barrera V, Carrasco-Garrido P, Santos-Sancho JM, Jiménez-García R. Influenza vaccination coverage rates among diabetes sufferers, predictors of adherence and time trends from 2003 to 2010 in Spain. *Hum Vaccin Immunother*. 2013 Jun;9(6):1326-32. doi: 10.4161/hv.23926. Epub 2013 Feb 12. PMID: 23403458; PMCID: PMC3901826.
28. Satman I, Akalin S, Cakir B, Altinel S; diaVAX Study Group. The effect of physicians' awareness on influenza and pneumococcal vaccination rates and correlates of vaccination in patients with diabetes in Turkey: an epidemiological Study "diaVAX". *Hum Vaccin Immunother*. 2013 Dec;9(12):2618-26. doi: 10.4161/hv.25826. Epub 2013 Jul 25. PMID: 23887188; PMCID: PMC4162054.
29. A cross sectional survey to evaluate knowledge, attitudes and practices regarding seasonal influenza and influenza vaccination among diabetics in Pretoria, South Africa. Olatunbosun OD, Esterhuizen TM, Wiysonge CS. *Vaccine*. 2017 Nov 7;35(47):6375-6386. doi: 10.1016/j.vaccine.2017.10.006. Epub 2017 Oct 14.
30. Alvarez CE, Clichici L, Patricia Guzmán-Libreros A, Navarro-Francés M, Ena J. Survey of vaccination practices in patients with diabetes: A report examining patient and provider perceptions and barriers. *J Clin Transl Endocrinol*. 2017 Jun 23; 9:15-17. doi: 10.1016/j.jcte.2017.06.002. PMID: 29067263; PMCID: PMC5651284.
31. Dos Santos G, Tahrat H, Bekkat-Berkani R. Immunogenicity, safety, and effectiveness of seasonal influenza vaccination in patients with diabetes mellitus: A systematic review. *Hum Vaccin Immunother*. 2018;14(8):1853-1866. doi: 10.1080/21645515.2018.1446719. Epub 2018 Apr 9. PMID: 29517396; PMCID: PMC6149986
32. Feng W, Cui J, Li H. Determinants of Willingness of Patients with Type 2 Diabetes Mellitus to Receive the Seasonal Influenza Vaccine in Southeast China. *Int J Environ Res Public Health*. 2019 Jun 21;16(12):2203. doi: 10.3390/ijerph16122203. PMID: 31234404; PMCID: PMC6617503.
33. Morales KF, Brown DW, Dumolard L, Steulet C, et al. Seasonal influenza vaccination policies in the 194 WHO Member States: The evolution of global influenza pandemic preparedness and the challenge of sustaining equitable vaccine access. *Vaccine*. X.2021Volume 8,100097, ISSN 2590-1362, <https://doi.org/10.1016/j.jvacx.2021.100097>.