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Original Article

The Overview of Government-Funded Influenza Vaccination Program during Influenza Season 2011-2012

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Abstract

Influenza vaccination is publicly known as the most effective method for preventing influenza infection. To protect the public's health, the Department of Health started to launch influenza vaccination programs since 1998, focusing on high-risk groups. In the government-funded influenza vaccination program for influenza season 2011-2012, trivalent inactivated influenza vaccines (TIV) were used in six high-risk groups, including the elders aged more than 65 years, children aged six months through six years and elementary school students from grade one through four, residents and staff in nursing homes and other long-term care facilities, healthcare and public health personnel, poultry or livestock farmers and animal health inspectors, and people with catastrophic illness. The influenza vaccine uptake rates for each high-risk group were obtained via the Influenza Vaccine Information System (IVIS). During the influenza season 2011-2012, 2,582,859 doses of influenza vaccines were inoculated. The coverage rates for each group were as follows: the elders aged more than 65 years: 40.2%; pre-school children aged above six months with at least one dose: 31.9%, with complete vaccination: 28.7%, with partial vaccination: 7.2%; elementary school students from grade one through four : 72.2%; high-risk groups above fifth grades in elementary schools and aged less than 65 years : 41.2%. Overall, the coverage rates for each high-risk group increased significantly comparing with the 2010-2011 influenza season. The coverage rate increased by 4% for adult groups, by 2.7% for elementary school children, and by 6.2% for infants and toddlers aged less than six years. The coverage rate increased the most for infants and toddlers comparing with those for other groups, but was still lower than the rates in the past, leaving room for improvement.

Keywords: influenza season, influenza vaccine, coverage rates of influenza vaccine, influenza vaccination program

Background

On average, about two million people contract influenza annually in Taiwan. During the influenza season 2010-2011, for example, the incidence rate of influenza-related complications was 66.1 cases per one million persons, with the highest rate of 255.4 cases per one million persons for those aged more than 65 years, followed by the rate of 58.3 to 84.1 cases per one million persons for those aged less than six years. In addition, the mortality rate of influenza-related complications was 30.5 deaths per one million persons for those aged more than 65, which was also the highest among all age groups according to the database from Centers for Disease Control (CDC), Department of Health. Therefore, influenza is an important public health issue in Taiwan, and influenza vaccination is publicly known as the most effective method for preventing influenza infection. To protect the public's health, the Department of Health has launched annual influenza vaccination programs since 1998, looking forward to improving the coverage rates for high-risk groups and extending the spectrum of target groups by year based on the recommendations from the Advisory Committee on Immunization Practices (ACIP) and the financial resources.

Annual influenza vaccination program

The government-funded influenza vaccination program in 2011-2012, resuming the international consensus, targeted on improving the coverage rates for high-risk groups. It was announced before the launch of program that those who were not eligible for the program were advised to vaccinate at their own expense. The high-risk groups included the elders aged more than 65 years, children aged six months through six years and elementary school students from grade one through four, residents and staff in nursing homes and other long-term care facilities, healthcare and public health personnel, poultry or livestock farmers and animal and health inspectors, and people with catastrophic illness. [1], comprising 5 million and 358 thousand people, which was about 23.3% of whole population in Taiwan. The CDC, by the commission from local governments of Taipei City, New Taipei City and Taoyuan County, purchased additional vaccines for the fifth and sixth graders in elementary schools.

The influenza vaccines offered in government-funded influenza vaccination program in 2011-2012 were trivalent inactivated vaccines, which contained the antigenic contents without residual viral activity. The antigenic contents, which were recommended by World Health Organization (WHO) for the northern hemisphere in 2011-2012, included A/California/7/2009 (H1N1)-like virus, A/Perth/16/2009 (H3N2)-like virus, and B/Brisbane/60/2008-like virus.

The influenza vaccination program during the influenza season 2011-2012 launched from October 1st 2011 and ended on June 30th 2012, and was implemented by the public health network composed of the CDC (and its branches), public health bureaus, public health centers, and contracted healthcare facilities. There were totally about 4,000 executive

organizations participating in the program. The vaccines were inoculated mostly in contracted healthcare facilities. During the program implementation period, 3,000 sessions of inoculation services were provided in communities, in schools and at homes. In addition, in order to improve the correct understanding of influenza vaccines for healthcare and public health personnel, the certification of “Influenza Vaccine” lesson was considered the prerequisite of qualified contracted healthcare facilities. The Taiwan Immunization Vision and Strategy (TIVS) was also commissioned to hold 12 training sessions of “Influenza Vaccine” for healthcare personnel. Meanwhile, each public health bureaus held at least one related training session locally.

Materials and Methods

1.Collection of inoculation data

During the execution period of influenza vaccination program in the influenza season 2011-2012, the inoculation data of government-funded vaccines were collected and managed through Influenza Vaccine Information System (IVIS) on internet. The healthcare facilities responsible for inoculations reported the inoculation numbers to the system every day from October 1st 2011 to February 13th 2012, reported every week from February 14th 2012 to April 9th 2012, and reported every 30 days from April 10th 2012 to June 30th 2012. The contracted healthcare facilities could check and modify the data on that day by themselves. The revision of the data of other days was under the control mechanism from the higher-level health management organizations to ensure the correctness and completeness of the data.

The inoculation numbers were based on the data reported by contracted healthcare facilities to the system. The number of people in high-risk groups of those aged more than 65 years and the pre-school children aged more than six months was based on the midyear populations proclaimed by Ministry of the Interior in 2011; the number of first to fourth graders in elementary schools was based on the data proclaimed by Ministry of Education. The other high-risk groups that were not categorized by age were based on the calculations by individual executive organization.

2.Reporting of inoculation data

During the program implementation, the inoculation data of each high-risk group were collected continuously through the information system. The reporting authorities would be added or canceled by the system when contracted health facilities joined or quitted the program or the distributed vaccines were run out, so that the reporting burden and the error rates of data from the participating healthcare facilities could be managed. There were 3,572 organizations that were required to report the data.

The inoculation numbers should be reported by categories of high-risk group. The participation rate of the inoculation data reporting was 100%; 93% of the data were reported within time limits; 94.6% of the data were correct without being revised, and the ratio of revision of the data was about 6.0%.

Results

Coverage rates of influenza vaccination for each high-risk group

1.Elders aged more than 65 years

The total vaccinated population of the elders aged more than 65 years was 1,011,008 persons, with the average coverage rate of 40.2%, which was higher than the coverage rate of 36.4% in last influenza season 2010-2011 (Table 1).

2.Children aged between six months and six years (pre-elementary school)

The total vaccinated population of the children aged between six months and six years was 331,846 persons. The coverage rate of at least one dose of influenza vaccine was 31.9%, which was higher than the rate of 25.9% in last influenza season. Based on the package insert of influenza vaccines, those aged less than nine years and were inoculated for the first time should receive two doses in the same influenza season to generate enough protection, which is regarded as complete vaccination. According to the completeness of vaccination, the coverage rate with complete vaccination for the group was 28.7%, and the coverage rate with partial vaccination was 7.2%; both were higher than the coverage rate of complete vaccination, 23.8%, and the coverage rate of partial vaccination, 4.6%, in last influenza season (Table 2).

For inactivated vaccine, the dose for children aged 6-35 months is 0.25mL, and the dose for children aged more then 36 months is 0.5mL. By the dosage and age of vaccinees, the coverage rate of at least one dose of influenza vaccine for children aged 6-35 months was 40.2%, while the coverage rate of complete vaccination for them was 33.9%, which were higher than the coverage rate of at least one dose, 26.3%, for pre-school children aged more than three years and the coverage rate of complete vaccination, 25.2% (Table 3, 4).

Table 1. The coverage rates for the elders aged more than 65 years during recent three influenza seasons from 2009 to 2011

Influenza season	No. of inoculations	Coverage rate
2011-2012	1,011,008	40.2%
2010-2011	902,253	36.4%
2009-2010	932,885	37.6%

Table 2. The coverage rates for the children aged between six months and six years old (pre-elementary school) in recent three influenza seasons from 2009 to 2011

Influenza season	No. of inoculations	Coverage rates of at least one dose	Coverage rates of complete vaccination	Coverage rates of partial vaccination
2011-2012	331,846	31.9%	28.7%	7.2%
2010-2011	289,419	25.9%	23.8%	4.6%
2009-2010	381,870	28.5%	24.8%	8.5%

Table 3. The coverage rates for children aged 6-35months in recent three influenza seasons from 2009 to 2011

Influenza season	No. of inoculations	Coverage rates of at least one dose	Coverage rates of complete vaccination	Coverage rates of partial vaccination
2011-2012	168,232	40.2%	33.9%	9.2%
2010-2011	162,972	32.9%	29.3%	5.7%
2009-2010	253,993	60.8%	43.2%	11.9%

Table 4. The coverage rates of children aged between three years and six years (pre-elementary school) in recent three influenza seasons from 2009 to 2011

Influenza season	No. of inoculations	Coverage rates of at least one dose	Coverage rates of complete vaccination	Coverage rates of partial vaccination
2011-2012	163,614	26.3%	25.2%	3.9%
2010-2011	126,447	20.3%	19.5%	2.8%
2009-2010	127,877	15.2%	13.9%	4.2%

3.The coverage rates for the first to fourth graders in elementary schools

The total number of vaccinated first to fourth graders in elementary schools was 646,496 persons, and the average coverage rate was 72.2%, which was higher than the coverage rate of 68.6% of the last influenza season (Table 5).

The coverage rates for each grader were 71.0% for the first graders, 72.3% for the second graders, 72.0% for the third graders, and 73.3% for the fourth graders. The rates for each grader were 2.4-4.6% higher than the rates of last year, and the rates were also higher for high graders.

4.High-risk groups above fifth grades in elementary schools and aged less than 65 years

The high-risk groups above fifth grades in elementary schools and aged less than 65 years, included people with catastrophic illness, staff in nursing homes and other long-term care facilities, healthcare and public health personnel, poultry or livestock farmers and animal health inspectors. The number of vaccinees among these groups was totally 350,294 persons, and the coverage rate was 41.2%, which was higher than the rate of 38.4% of the last influenza seasons. The coverage rates for each group were as follows (Table 6).

Table 5. The coverage rates for the first to fourth graders in elementary schools in recent three influenza seasons from 2009 to 2011

Influenza season	No. of inoculations	Coverage rates
2011-2012	646,496	72.2%
2010-2011	659,020	68.6%
2009-2010	818,235	79.6%

Table 6. The coverage rates for high-risk groups above fifth grades in elementary schools and aged less than 65 years

High-risk groups	No. of inoculations	Coverage rates
persons who have catastrophic illness	38,691	_
Staff in nursing homes and other long-term care facilities	27,246	85.1%
Healthcare workers	243,005	88.4%
Public health workers		
Infection control workers	11,581	91.1%
Emergency medical technicians	5,714	56.5%
Airborne service corps	118	44.2%
Coast guards	6,990	69.4%
Border control workers	1,538	15.8%
Animal farm-related workers		
Poultry or livestock farmers	14,273	59.2%
Animal health inspectors	1,138	45.6%

The number of vaccinees among the staff in nursing homes and other long-term care facilities was 27,246 persons, and the coverage rate was 85.1%, which was higher than the rate of 70.8% of the last influenza season.

Healthcare workers include the registered medical professionals and the general staff in healthcare facilities. According to the survey, the number of vaccinees among the healthcare workers was 243,005 persons, and the coverage rate was 88.4%, which was higher than the rate of 88.1% of the last influenza season. Among the healthcare workers, the coverage rate for the registered professionals was 98.2%, which was higher than the rate of 71.6% for general staff.

Public health workers include infection control workers, coast guards, emergency medical technicians, staff of airborne service corps, and border control workers who are in charge of security check at the entry of international airports or harbors, immigration inspections, and the front-line Customs. The number of vaccinated public health workers was 25,941 persons. The overall coverage rate was 85.2%, which was higher than the rate of 61.0% of the last influenza season. Among these groups, the coverage rate for infection control workers was the highest, which was 91.1%, followed by the rate for coast guards: 69.4%, for emergency medical technicians: 56.5%, for staff of airborne service corps: 44.2%, and for border control workers: 15.8%. The coverage rates for all groups increased by 3.6% to 19.5% compared with those of last years, except for coast guards.

The total number of vaccinated poultry or livestock farmers and animal health inspectors were 15,411 persons and the overall coverage rate was 57.9%, which was higher than the rate of 44.0% of the last influenza season. Among these groups, the coverage rate for poultry or livestock farmers was 59.2%, which was higher than the rate of 45.6% for animal health inspectors. The rates for both groups increased by 10.1% to 15.2% compared with the rates of last year.

Discussion and Conclusion

The number of influenza vaccine inoculations in Taiwan was collected through the information system on internet, which led to the convenience and timeliness on data collection. To maintain the timely effectiveness in data retrieval, the dual mechanisms of claiming function had been set up in the system and manually for process control. The correctness of reporting data was assured by verifying the register rosters while receiving vaccines and irregularly inspecting the balances of vaccines. In addition, the information system was established in 2007, and for the contracted healthcare facilities, the proficiency in reporting the data through the system improved gradually. Therefore, the analysis and interpretation of the data collected through the system were more precise and reliable compared with the survey methods of coverage rate calculations used in United Kingdoms

and United States [2,3].

The coverage rates increased compared with the rates of last year for healthcare workers, public health workers, staff in nursing homes and other long-term care facilities, poultry and livestock farmers, children aged between three and six years, and people with catastrophic illness. Among these groups, the rate increased the most for public health workers, indicating that the result of vaccination promotion was much significant for the groups with relatively greater awareness of public health. The unchanged risks of avian influenza might lead to decreased vaccine coverage rates for those who could have contact with poultry, such as poultry or livestock farmers and coast guards. Their awareness of self-protection should be raised and influenza vaccination should be promoted.

Overall, the coverage rates for all high-risk -groups in the program during the influenza season 2011-2012 increased significantly compared with the rates of previous influenza season. The rates increased by 4% for adult groups, by 2.7% for elementary school children, and by 6.2%, the greatest range of increase, for children aged less than six years. The increases in the coverage rates could be attributed to the strengthening of healthcare workers' knowledge of influenza vaccines before the implementation of the program, the establishment of the mechanisms for program advocacy and assisted health education by medical professionals, and the announcement that the government-funded vaccines were not expanded to general public. Besides, the announcement that the vaccines were not provided for other candidates in mid-October 2011, and no media reports of vaccine-associated adverse events may have been factors contributed to the promotion of coverage rates. However, the coverage rate for those aged more than 65 years was 40.2%, which was ranked 17th out of 21 members in Organization for Economic Co-operation and Development (OECD) [4], and was much lower than the expected target, 75% by 2010, recommended by WHO in 2005 [5]. The coverage rate for children aged less than six years followed an upward trend during the influenza season 2011-2012, but was at the relatively low point over the years. For pre-school children aged between three and six years, the coverage rate was increasing every year. In the future, we should keep on promoting vaccination advocacies, improving the accessibility to vaccination, and enhancing the awareness of prevention from influenza in kindergartens. We may expect that these actions should be helpful in increasing the coverage rates for these groups.

During the program implementation, vaccinees could decide where they wanted to be vaccinated of their own free will, not confined to their registered residences. Therefore, the site selection was affected by factors such as the distribution of medical resources. The IVIS only recorded the numbers of inoculations by vaccination station, so the statistics could only represent the vaccination workload by county or city, rather than the actual coverage rates by registered residence. However, the overall coverage rate was not affected. For the vaccinees who were not categorized by age, such as public healthcare personnel, health workers or poultry or livestock farmers, the coverage rates only reflected the status of those who were surveyed rather than all persons in the groups because of the frequent personnel changes and

the limitations on the completeness of the survey.

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Correlation between Community-based Volunteers' Involvement in Diseases Prevention and Coverage Rate of Influenza Vaccination

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Abstract

Recruiting community-based volunteer to participate and assist in community diseases prevention was one strategy of the National Influenza Pandemic Preparedness Plan – Phase II. Since 1997, Centers for Disease Control in Taiwan (Taiwan CDC) has granted local health bureaus to organize, integrate and assign community-based volunteers to assist education in epidemic prevention and control measures for infectious diseases. In 2011, local health bureaus started to involve the volunteers in flu vaccination propaganda. This study aimed at the correlation between community-based epidemic preventive volunteers' assistance in influenza vaccination and its coverage rate on target population. We analyzed the person-time data of community-based volunteers' involvement in influenza vaccination offered by local health bureaus, as well as the coverage rate of influenza vaccination on target population in 2010 and 2011. The results showed a significant correlation between the rising coverage rates of influenza vaccination on the elderly over 65 years of age and the person-time ratio of volunteers' service, while the coverage rates of influenza vaccination on children under six years old and the person-time ratio of volunteers' service were not related. This study revealed the effectiveness of volunteers' involvement in enhancing the influenza vaccination rate, but only for elderly population over 65 years of age. It is suggested that might due to the policy of aging-in-place, and the age of community-based epidemic preventive volunteers. As for influenza vaccination of children under six years of age, it is recommended to identify and analyze the main factors affecting immunization rates in this group, so that we can figure out the way that epidemic preventive volunteers can involve in achieving the goal of improving vaccination rates.

Keywords: community-based epidemic prevention, community-based epidemic preventive volunteer worker, Influenza vaccine

Foreword

Influenza is the disease with the most potential of causing global pandemic. Whether it is the seasonal flu which annually causes epidemic worldwide, or H5N1 avian influenza that is persistent since at the end of 2003, as well as the 2009 (H1N1) influenza pandemic, all remind

us of its threat to humankind. Thus many countries have reviewed their control measures in response to influenza pandemic after experienced the outbreaks of SARS and 2009 (H1N1) influenza pandemic [1].

Take advantage of community manpower in promoting public health has been around for years internationally. The United States has made community health volunteers maintaining public health in the early 1960s. By the 1980s, community health volunteers developed more vigorously and became important providers of medical resources for inhabitants in remote areas. In some areas, they even were the only available health care resource. In addition, recent studies have found that community health workers can also help the minorities who can not access the traditional medical system in urban areas [2].

The application of community-based health volunteers is more valued in Taiwan. For instance, the Ministry of the Interior has initiated the “Taiwan Six-Star Healthy Community Project” to invite community-based volunteers assisting in relative works since 2005. Another example is the "Healthy Cities Project” launched by the Department of Health, which aims to link up community health settings with local resources and encourage community members to concern and solve community health issues [3, 4]. Taiwan CDC has granted local health bureaus since 2008 to organize, integrate and assign the existing community-based volunteers to assist health staff in health education and community epidemic prevention [5]. Moreover, it requested the local health bureaus to involve community-based epidemic preventive volunteers in assisting the influenza vaccination promotion during 2011 influenza vaccination period from October to December.

In order to clarify the effectiveness of vaccination increasing rate with the manpower of community-based epidemic preventive volunteers involving in influenza vaccination promotion, Taiwan CDC requested the local health bureaus to recruit volunteers to involve in 2011 influenza vaccination program. It also collected the results of 2010 and 2011 influenza vaccination for comparative analysis as reference for making vaccination policy in the future.

Materials and Methods

The data source of the community-based epidemic preventive manpower involvement study was collected from the “Statistical results of community-based epidemic preventive manpower assisting the health bureau in promotion of influenza vaccination activities” from October to December 2011, compiled by health bureaus in 22 counties and cities countrywide. We calculated the person-time of volunteers involved in influenza vaccination program on the items including household visits, door-to-door reminder, body temperature measurement prior to inoculation, consultations and order maintenance /care at inoculation stations, health education on the phone, consultations, as well as advocating influenza vaccination in community activities.

Total person-time of volunteers’ service divided by community volunteer numbers of each counties and cities was person-time ratio of volunteers’ service. This study used person-time

ratio of volunteers' service to represent the manpower involvement in community-based epidemic prevention of each counties and cities. The vaccination coverage rate was collected from vaccination rate of target groups in 2010 and 2011 influenza vaccination program, including elderly over 65 years old, 3-6 year old children, and children under three years old, respectively. The increasing rates of vaccination are the two years difference of the vaccination rate for each age group.

Statistically, descriptive analysis was conducted with SPSS14.0 Chinese version, and we used Mann-Whitney U test and Chi-Square test to analyze the differences and correlation between person-time ratio of volunteers' service and vaccination increasing rate for each age group (elderly over 65 years old, 3-6 year old children, and children under three years old).

Mann-Whitney U test was to make all sample data into ordinal ranking. Then we calculated the sum of ranks for two samples and test for the difference. Due to the limit of the number of samples, the results of Chi-Square test were also tested by Fisher's exact probability test.

Results

The results of volunteers assisting the health bureaus in promoting influenza vaccination activities were shown in Table 1. The household visits had totally 54,372 person-times, and Tainan City was the highest (15,281 person-times). Door-to-door reminder services accounted for 166,532 person-times, and New Taipei City was the highest (30,619 person-times). Body temperature measurement service prior to inoculation accounted for 387,978 person-times, and

Table 1. The results of volunteers assisting the health bureaus in promoting epidemic preventive activities on influenza vaccination in counties and cities, Taiwan

	Household visits	Door-to-door reminder	Body temperature measurement prior to inoculation	Order maintenance /care at inoculation stations	Consultation services at inoculation stations	Health education and consultation on the phone	Organize community activities	Other	Total
Keelung City	1,657	1,019	7,455	8,544	8,070	1,466	2,230	80	30,521
Taipei City	51	19,938	17,453	28,614	28,414	11,874	4,219	6,291	116,854
New Taipei City	6,305	30,619	91,724	86,907	53,317	8,086	17,002	13,014	250,740
Taoyuan County	429	11,112	36,422	29,524	14,482	14,892	21,882	3,381	145,649
Hsinchu City	2,370	25,900	6,070	6,070	6,070	3,870	5,620	0	55,970
Hsinchu County	1,087	2,473	24,406	24,406	19,794	2,486	14,770	0	178,844
Miaoli County	188	3,435	10,840	10,373	7,285	726	1,402	9,653	41,722
Taichung City	314	1,100	39,737	35,001	17,399	5,121	9,030	380	108,082
Changhua County	5,219	2,940	16,636	26,880	18,087	5,090	5,897	200	80,949
Nantou County	294	332	1,800	1,980	1,205	945	1,631	460	8,107
Yunlin County	11,118	13,534	4,744	3,804	4,036	2,832	3,930	30,148	74,146
Chiayi City	0	0	8,932	8,932	8,932	0	6,278	0	15,210
Chiayi County	549	5,505	33,128	27,259	13,551	9,339	15,959	8,900	114,190
Tainan City	15,281	12,702	51,500	43,185	35,206	14,190	9,881	16	182,017
Kaohsiung City	0	0	0	0	0	0	27,718	0	27,718
Pingtung County	5,791	4,736	10,378	8,951	7,809	3,128	7,186	877	48,856
Taitung County	1,458	2,460	3,888	3,028	2,066	822	3,415	3,020	20,157
Hualien County	275	528	5,711	6,106	4,289	3,675	1,665	3,810	26,059
Yilan County	1,303	25,592	9,799	7,273	5,593	14,841	12,937	0	77,338
Penghu County	0	0	3,375	3,375	3,068	0	32	0	9,850
Kinmen County	510	1,516	3,651	2,137	1,606	1,118	727	0	11,265
Lienchiang County	173	1,091	329	329	329	900	1,375	1,340	5,866
Total	54,372	166,532	387,978	372,678	260,608	105,401	174,786	81,570	1,630,110

New Taipei City was the highest (91,724 person-times). Order maintenance/care at inoculation stations were 372,678 person-times, and New Taipei City was the highest (86,907 person-times). Consultation service at inoculation stations had 260,608 person times, and New Taipei City was the highest (53,317 person-times). Health education and consultation on the phone were 105,401 person-times, and Taoyuan County was the highest (14,892 person-times). Organize community activities accounted for 174,786 person-times, and Kaohsiung City was the highest (27,718 person-times).

As for the vaccination rate, 2011 vaccination rates were all increased on elderly over 65 years old, 3-6 year-old children, and children under three years old, compared to the rates of 2010. Among them, the rate for the elderly over 65 years old increased by 4.01%, 3-6 year old children lift 4.85%, while children under three years of age rose 9.73%, and the overall vaccination rate increased by 4.96% for all three target groups. Geographically, the vaccination rate of the elderly over the age of 65 had risen in almost all counties and cities except Kinmen County and Lienchiang County, with the highest increase of 5.81% in Tainan City. The vaccination rate of children aged three to six had risen in almost all counties and cities except Chiayi City and Penghu County, with the highest increase of 9.75% in Keelung City. The vaccination rate of children under three years old had risen in all counties and cities, and Taitung County was the highest with 14.01% increase. As for volunteer services, there were a total of 9,195 community-based epidemic preventive volunteers nationally, with the highest of 1,117 volunteers in Changhua County. There were totally 1,630,110 person-times for services by community-based epidemic preventive volunteers countrywide, while the highest was in New Taipei City with 250,740 person-times. National person-time ratio of volunteers' service (total person-times of volunteers' service divided by community volunteer numbers) was 177, and the highest was 759 services by each volunteer in Taipei City (Table 2).

Table 2. The increasing rate of influenza vaccination and the services by community-based epidemic preventive volunteers for counties and cities in 2011

	Increasing rate of vaccination for three target groups (%)				Volunteer services for counties and cities		
	Elderly over 65 years old	Children under 3 years old	3-6 year old children	All tree target groups	Community volunteer numbers (A)	Person-time of volunteers' service (B)	Person-time ratio of volunteers' service (B/A)
Keelung City	4.59	12.38	9.75	6.10	156	30,521	196
Taipei City	3.68	7.56	4.45	4.27	154	116,854	759
New Taipei City	5.16	10.88	6.96	6.35	916	250,740	274
Taoyuan County	4.20	13.44	5.51	5.97	309	145,649	471
Hsinchu City	5.03	12.23	3.19	6.27	147	55,970	381
Hsinchu County	3.89	10.20	4.58	5.11	256	178,844	699
Miaoli County	3.50	8.12	2.21	4.06	396	41,722	105
Taichung City	3.67	9.52	3.84	4.63	870	108,082	124
Changhua County	5.46	11.52	7.68	6.73	1,117	80,949	72
Nantou County	3.06	11.66	4.00	4.20	324	8,107	25
Yunlin County	4.20	7.16	7.59	4.99	458	74,146	162
Chiayi City	1.76	13.24	-0.44	2.14	233	15,210	65
Chiayi County	2.30	9.05	5.18	3.70	363	114,190	315
Tainan City	5.81	6.49	0.16	5.03	854	182,017	213
Kaohsiung City	3.47	8.70	5.24	4.54	387	27,718	72
Pingtung County	2.55	7.82	5.51	3.70	545	48,856	90
Taitung County	5.10	14.01	8.39	6.67	501	20,157	40
Hualien County	3.58	11.66	0.57	4.28	361	26,059	72
Yilan County	2.56	12.06	2.98	3.46	377	77,338	205
Penghu County	1.70	4.27	-0.10	1.97	91	9,850	108
Kinmen County	-0.56	2.90	3.01	0.85	236	11,265	48
Lienchiang County	-3.56	13.06	3.11	0.36	144	5,866	41
Standard deviation	2.11	3.02	2.79	1.78	282	67409	206
Minimum	-3.56	2.9	-0.44	0.36	91	5866	25
Maximum	5.81	14.01	9.75	6.73	1117	250740	759
Total	4.01	9.73	4.85	4.96	9,195	1,630,110	177

Analysis of the correlation between vaccination rates for different target groups and person-time ratio of community-based epidemic preventive volunteers' service in 22 counties and cities, we found a significant correlation (P = 0.034) between person-time ratio of volunteers' service and the vaccination increasing rate among elderly over 65 years old. The average vaccination rate among elderly over 65 years old in the counties and cities with high person-time ratio of volunteers' service (top 11 counties and cities) was higher than it in the counties and cities with low ratio (last 11 ranks of counties and cities). The counties and cities with high person-time ratio of volunteers' service had higher vaccination increasing rate among elderly over 65 years old. The vaccination increasing rates among the other two groups had no significant correlation with person-time ratio of community-based epidemic preventive volunteers' service (Table 3).

As for the differences between high and low vaccination increasing rates for different target groups and high and low person-time ratio of volunteers' service, it showed significant differences (P = 0.043) between overall vaccination increasing rate and person-time ratio of volunteers' service. Among different age groups, it was a significant difference (P = 0.004) between vaccination increasing rates among elderly over the age of 65 and person-time ratio of volunteers' service, while it was no difference for the other two target groups. That showed a significant correlation between vaccination increasing rates for elderly over 65 years old and high person-time ratio of volunteers' service (Table 4).

Table 3. The difference between high and low person-time ratio of volunteers' service on vaccination rates for different target age groups

	Person-time ratio of volunteers' service (N=22)		
	High	Low	P value
Elderly over 65 years old			0.034*
Number	11	11	
Average level of vaccination rate	14.45	8.55	
Sum of the levels	159	94	
Children under 3 years old			1.000
Number	11	11	
Average level of vaccination rate	11.45	11.55	
Sum of the levels	126	127	
3 - 6year old children			0.332
Number	11	11	
Average level of vaccination rate	12.91	10.09	
Sum of the levels	142	111	
Total			0.088
Number	11	11	
Average level of vaccination rate	13.91	9.09	
Sum of the levels	153	100	

Average level of vaccination rate = Sum of the levels÷Number *P<0.05

Table 4. The correlation between vaccination increasing rates for each target group and person-time ratio of volunteers' service

	Person-time ratio of volunteers' service (N=22)		P value
	High N (%)	Low N (%)	
Vaccination increasing rates for elderly over 65 years old			0.004**
High	9(81.8)	2(18.2)	
Low	2(18.2)	9(81.8)	
Vaccination increasing rates for children under 3 years old			0.5
High	5(45.5)	6(54.5)	
Low	6(54.5)	5(45.5)	
Vaccination increasing rates for 3-6 year old children			0.197
High	7(63.6)	4(36.4)	
Low	4(36.4)	7(63.6)	
Overall vaccination increasing rates			0.043*
High	8(72.7)	3(27.3)	
Low	3(27.3)	8(72.7)	

**P<0.01 *P<0.05

Discussion and conclusion

This study revealed that there is a significant correlation between community-based volunteers' involvement in epidemic prevention and influenza vaccination rate among elderly over 65 years old. After community advocacy, community residents have improved their health status and health awareness. Also, community–based volunteers have a positive impact on the medical accessibility [2]. That showed the feasibility to improve the public health behavior and cognition by community intervention, and consistent with the results of this study.

In response to the challenge of rapid population aging and elderly care in Taiwan, domestic scholars referenced to the experience of OECD countries and proposed "aging-in-place" as the development goal of long-term care policy, which suggested "the senior citizens should age naturally in their communities to maintain their life quality of autonomy, self-esteem and privacy" [6]. The Ministry of the Interior is drafting "Senior Citizens Welfare Act" following the development of "aging-in-place". The main contents of the act are to increase community services, enrich the home services, and actively establish community care centers [7]. These measures will connect the community care organizations and the elderly population in the community, and will also effectively introduce the correct personal hygiene, the concept of health and the governmental health policies to senior citizens. Due to the elderly mostly take activities in the communities, the community-based epidemic preventive volunteers can largely increase contact with the elderly to enhance health education and improve their approval on governmental health policies, making higher acceptance of influenza vaccination for the elderly population.

In this study, the community-based volunteers involved in epidemic prevention were 50 to 70 years old, and some of them were older than 70 years. In productivity, these elderly populations may pay more attentiveness than labor, but their years experience and harmony are helpful to promote governmental policies, health knowledge and community motivation [8, 9]. Compared to children under the age of six, since community-based epidemic preventive volunteers had frequent contacts and had similar age and values with people over the age of 65, the age group of over 65 tended to be more supportive on the vaccination policy and willing to participate in vaccine immunization activities.

Although involvement by community-based epidemic preventive volunteers was effective on increasing rate of influenza vaccination for all three target groups, only elderly over 65 years old had significantly association. It might be related to the aging-in-place policy and aged volunteers.

In addition, the study found that influenza vaccination rates for the elderly over the age of 65 were lower in municipalities and higher in other counties and cities. For instance, Hualien County, Chiayi City and Changhua County are the top three cities with high vaccination rates for the elderly over the age of 65. This result was consistent with the study for the veterans by Leslie et al. They revealed that veterans more likely had higher

participation and support in community health services in rural areas than in urban areas that might due to the veterans considered the community health service centers as important sources of medical care since doctors and medical resources were insufficient in rural areas [10]. We suggested that less available medical resources in non-municipalities might result in closer relationship of community residents with epidemic preventive volunteers or with first line health units and yielded higher vaccination rates than people in municipalities.

In summary, the involvement of community-based epidemic preventive volunteers significantly helped to increase the influenza vaccination rate for target groups, especially for elderly over 65 years old. The reason was suggested due to the aging-in-place policy and the similar age to those epidemic preventive volunteers. According to the result, to identify the key factors which affect the target groups and involved in community-based epidemic preventive volunteers should be able to make good effectiveness. Therefore, to increase the influenza vaccination rate for children younger than 6 years old, it is considered to recruit younger people, baby sitters and preschool teachers for epidemic preventive volunteers. With their closer relationship with parents of young children, it might be a feasible strategy to increase influenza vaccination rate for children under six years old.

Limitations and recommendations

The main limit of this study is small sample size, making limited selection and use of inferential statistical methods. Furthermore, with regard to the vaccination rates, there may be other affecting factors we are not aware in addition to the involvement of community-based epidemic preventive volunteers. Thus we can not exclude the confounders such as policies, and seasonal influenza. For further researches in the future, besides to continuously collect relevant information and review literatures, we can enlarge the sample size and remove the possible confounders at the same time. In study design, other factors such as expected number of vaccination and local population may be considered. It is hoped to design a more accurate formula to calculate the capacity of involvement by community-based epidemic preventive volunteers.

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