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การศึกษาความสมบูรณ์ และการได้รับวัคซีนตรงตามกรอบเวลาก่อนและหลังการใช้งานสมุดวัคซีน สำหรับผู้รับบริการ ณ ศูนย์สร้างเสริมสุขภาพ โรงพยาบาลมหาวิทยาลัยบูรพา

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บทคัดย่อ

วัตถุประสงค์การวิจัย:เพื่อศึกษาความสมบูรณ์และการได้รับวัคซีนตรงตามกรอบเวลาก่อนและหลังการใช้งานสมุดวัคซีนสำหรับผู้รับบริการที่ศูนย์สร้างเสริมสุขภาพโรงพยาบาลมหาวิทยาลัยบูรพา

วิธีดำเนินการวิจัย:การศึกษาในครั้งนี้เป็นการศึกษาแบบย้อนกลับ เป็นการวิเคราะห์ข้อมูลการได้รับวัคซีนชนิด หลายเข็ม ของผู้ที่มารับบริการ ณ ศูนย์สร้างเสริมสุขภาพ โรงพยาบาลมหาวิทยาลัยบูรพา ได้นำเครื่องมือสมุดการบันทึกการได้รับวัคซีนส่วนบุคคล มาใช้ในการบันทึกการรับวัคซีนของผู้ที่มารับบริการ ซึ่งในการวิเคราะห์ข้อมูลได้เปรียบเทียบความแตกต่างของความสมบูรณ์ และการได้รับวัคซีนตรงตามกรอบเวลา ระหว่างกลุ่มที่ยังไม่ได้ใช้สมุดวัคซีนและกลุ่มที่มีการใช้สมุดวัคซีน โดยใช้การวิเคราะห์การถดถอยโลจิสติค ในการวิเคราะห์ความสัมพันธ์ของตัวแปรที่ศึกษาคือความสมบูรณ์และการตรงตามกรอบเวลาของการได้รับวัคซีนระหว่างที่ไม่ได้ใช้สมุดบันทึกการรับวัคซีนส่วนบุคคลและกลุ่มที่ได้ใช้สมุดบันทึกการรับวัคซีนส่วนบุคคล

ผลการวิจัย:จากการศึกษาพบว่า กลุ่มที่ใช้สมุดวัคซีนมีอัตราการสมบูรณ์ และการตรงตามกรอบเวลาในการได้รับวัคซีนสูงกว่าก่อนการใช้สมุดวัคซีนอย่างมีนัยสำคัญทางสถิติ (p-value < 0.001) และเมื่อวิเคราะห์คุณลักษณะของประชาการยังพบว่ากลุ่มอายุที่มากกว่า 35 ปีมีความสัมพันธ์กับการสมบูรณ์ และการตรงตามกรอบเวลาในการได้รับวัคซีนอย่างมีนัยสำคัญทางสถิติ (p-value < 0.001)

สรุปผล:ความสมบูรณ์และการตรงตามกรอบเวลาของการได้รับวัคซีนที่เพิ่มขึ้นจากกระบวนการใช้สมุดบันทึกการรับวัคซีนส่วนบุคคล เนื่องจากใช้สมุดบันทึกการรับวัคซีนส่วนบุคคลสามารถปรับให้มีความเหมาะสมและตอบสนองความต้องการของข้อมูลประชากรของผู้บริการวัคซีนเพื่อให้เกิดความสมบูรณ์และการได้รับวัคซีนครบถ้วนตามมาตรฐาน

คำสำคัญ: ความสมบูรณ์ของการรับวัคซีน, ความตรงตามกรอบเวลากำหนดการรับวัคซีน, สมุดวัคซีน

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Implementation of personal vaccination record (PVR) to increase completeness and adherence of multi-dose adult vaccination: a retrospective study at the wellness center, Burapha University Hospital

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Background: Failure to complete multi-dose vaccination was profound in adults globally. The reminder and recall system were proposed to improve immunization rates. We implemented the personal vaccination record (PVR) for adult vaccine services at the wellness center, Burapha University Hospital and measured completion and adherence rate before and after implementation.

Methods: This retrospective study analyzed multi-dose vaccine recipient data at the wellness center, Burapha University Hospital during 2019-2020. The PVR was implemented from 2020 onward; recipients who initiated the vaccine before and after PVR were categorized as pre-PVR and post-PVR groups, respectively. The outcomes were completeness and adherence rate. Completeness is defined as the completion of the standard vaccine series: 3 doses for Hepatitis B (HBV) and Human papilloma virus (HPV) vaccines, 2 doses for Measles-mumps-rubella vaccine (MMR) and varicella vaccine (VAR). Adherence is defined as receiving the vaccines per recommended schedule or within a window period of an additional one week.

Results: The completion and adherence rate were significantly higher in the post-PVR vs. pre-PVR group. The completion and adherence rate of post-VPR group were significantly higher than pre-VPR group (88.6% vs. 60.1% and 85.9% vs. 55.2% respectively). When adjusted for demographic data, PVR implementation and aged >35 years old were significantly associated with the completeness and adherence of multi-dose vaccine series.

Conclusions: Vaccination series completeness and adherence were higher after the PVR was implemented, especially among older adults. The PVR, or other forms of reminder systems, should be incorporated into every adult vaccination service to promote complete receiving recommended vaccines and immunization.

Keywords: Vaccine series completion, adherence, schedule, vaccine

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Introduction

After the pandemic of Coronavirus disease 2019 (COVID-19), health and well-being have become the priority of people worldwide. The traditional concept of "Prevention is better than cure."was reintroduced. Vaccination is among the most effective measures against diseases and transmission. The pandemic has increased vaccination awareness and acceptance among the adult population. A study in the United Kingdom found an increasing intention for influenza 2020-2021 vaccination for eligible adults, boosted after the COVID-19 pandemic.[1] In order to ensure a protective immune response and maximize vaccine cost-effectiveness, the vaccination process, including multi-dose vaccine schedules, should adhere to the manufacturer's recommendation.

However, incomplete multi-dose vaccination was reported as a problem globally. In a review of vaccine series completion among adolescent- including human papillomavirus vaccine (HPV), hepatitis A (HAV), hepatitis B (HBV), and varicella vaccines (VAR)- found completion rates ranged from 27% to over 90%.[2] The rate of completed vaccination was particularly lower in adolescent and young adult.[3] Studies from the United States found that only one-third of adults completely received HAV and HBV vaccination.[4] Suboptimal adherence and series completion rate (23-35%) was also described among adults in the United Kingdom receiving hepatitis vaccines.[5] The data among adult vaccine recipients were limited in Thailand.

Factors influencing successful vaccination can be considered upon many concepts. The World Health Organization (WHO) vaccine hesitancy model is composed of confidence, complacency, and convenience.[6] Confidence refers to a lack of trust in the effectiveness and safety of vaccines, health care personnel, or related system. Complacency refers to a low perceived risk of vaccine-preventable diseases and the fact that vaccines are important. Convenience refers to the degree of discomfort, inconvenient in time and place, of vaccine delivery system including the complexity of multiple series of vaccines. In terms of multi-dose vaccination, the vaccine reminder/recall system, as part of the convenience, has been shown to improve coverage compared to the control group.[7]

In a qualitative study among US adolescents who missed the final dose of the HPV vaccine, more than one-third claimed that they did not know and/or forgot to obtain further

doses.[8] Not only for the vaccine recipients, but a good reminder system will also assist health care personnel to provide vaccines per the most appropriate schedule. As the wellness center, Burapha University Hospital thrives to be an excellent center for health preventive medicine, the personal vaccination record (PVR) was implemented in January 2020. Regarding a scarce of local data, we conducted a retrospective study comparing the completion and adherence rate of multi-dose vaccine recipients in the wellness center before and after the implementation of personal vaccination records (PVR).

Methods and Materials

Research setting:

This research utilized retrospective vaccination data from the wellness center, Burapha University Hospital in Chonburi, Thailand. The center has extended the service toward preventive medicine, this includes the provision of vaccine to adult aged>18 years. There were 600 - 675 vaccine recipients during 2019-2020. This number has been increasing. The nurse who provides the vaccination will record related data as a routine process. The data include the vaccinees' demographics, type, date, and route of vaccinations. Multi-dose vaccinations are accounted for half of the overall vaccine services. These included HBV, HPV, measles-mumps-rubella (MMR) and, Varicella (VAR) vaccines. The PVR was implemented as a research and development project funded by the Faculty of Medicine, Burapha University. Vaccination schedule for HBV in this research is three muscular injections, the second and third doses are administered at 1 and 6 months, after the first dose respectively HPV vaccination schedule also consists of three muscular injections, the second and third doses are administered at 2 and 6 months, respectively after the first dose. For subcutaneous MMR and VAR vaccination schedule, the second dose is administered at 4 weeks after the first dose.

Before the PVR, the appointment of a multi-dose vaccine schedule was administered by pharmacists or nursing personnel, depending on the type of vaccine. The appointment date was printed and given to the recipient as a single piece of paper. Sometimes the appointment card was uninformed or lost. According to the recorded data, almost half of the recipients were unsuccessful to receive vaccines within appropriate schedule and 40% did not complete the vaccination during pre-PVR. The PVR was developed by multidisciplinary health care personnel involving in adult vaccine services The

format (Figure 1) was modified from the renowned national vaccination center and World Health Organization guidelines.[9] The nurse will fill in the vaccinee's demographic on the front page; vaccine-related detail along with the date of the next vaccination schedule are filled in and discussed with the recipient. There are contents to increase awareness of vaccine schedule and side effects on the back page. The PVR was implemented from January 2020 onward.

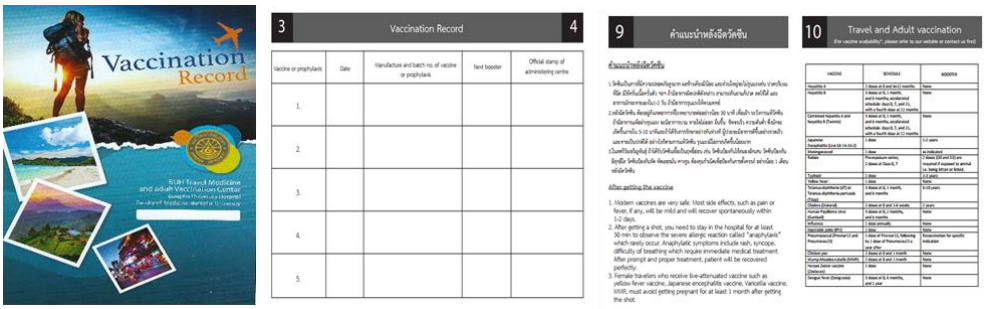

Figure 1 Format of Personal vaccination record (PVR) at the wellness center, Burapha University Hospital

Study population

Records of vaccine recipients aged 18 years or older who had received multi-dose vaccines (HBV, HPV MMR, Varicella) 1 year before and after PVR were retrieved. We excluded data of vaccine recipients who initiated multiple vaccine series at the same visit and booster doses or accelerated vaccine schedules were also excluded. We only collected the first type of vaccines if the recipient received more than one type of multi-dose vaccines during the study period.

Outcome measures

The primary study outcomes were (1) completion of the standard course of the multi-dose vaccines (defined in this study as HBV 3 doses, HPV 3 doses, MMR 2 doses, and VAR vaccine 2 doses) and (2) the adherence to the recommended timing of the vaccines as in Thai vaccination guideline for adult (Table 1). Statistic calculation was performed with the proportions of adults who completed two and three doses and the proportions who adhered to the recommended schedule or within one additional week after the appointment date. The comparison was made between recipients who came 1 year before PVR implementation (pre-PVR group) and 1 year after PVR (post-PVR group)

Table 1 Recommended adult administration schedules for Hepatitis B, HPV (Human Papilloma Virus), Measles-mumps-rubella, Varicella vaccine at the Wellness Center Burapha University Hospital

Vaccine	Recommended schedule			injection technique
	Dose 1	Dose 2	Dose 3	
Hepatitis B	0	1 month	6 months	muscular injection
Human Papilloma Virus	0	2 months	6 months	muscular injection
Measles-mumps-rubella	0	1 month	N/A	subcutaneous injection
Varicella	0	1 month	N/A	subcutaneous injection

Statistical analysis

Demographics of vaccine recipients, the proportion of vaccine series completion, and adherence were summarized descriptively, then categorized as pre-PVR and post-PVR groups. Categorical covariates were described as a number and percentage; continuous covariates were described as mean and standard deviation (SD). Comparisons between categorical and continuous variables in pre-and post-PVR groups were made using Chi-square and T-test respectively. All p-values reported are two-sided, and statistical significance was defined as $p < 0.05$. Logistic regression analysis was used to determine an odds ratio (OR) and 95 % confidence intervals (CI) for factors associated with vaccine series completion and adherence. Multivariable models were developed adjusting for demographic and covariates with $p < 0.1$ in univariate models. The study procedure was approved by the Burapha University Institutional Review Board.

Results

The data of 628 adults initiating multi-dose vaccination during 1 year before and after PVR were screened for eligibility. Forty-seven vaccinees were excluded because receiving more than one multi-dose vaccination in the same visit and ten vaccinees were excluded because of receiving only a booster dose. Therefore, a total of 571 vaccine recipients (308 and 263 from pre-PVR and post-PVR groups, respectively) were included in this analysis. Most vaccine recipients were Thai people with a mean age of 33 (SD=13.27) years; more than half (66%) of them were female (Table 2)

Table 2 Characteristics of adult (N=571), classified by vaccine series initiation before (pre-PVR) and after (post-PVR) implementation of personal vaccine record

	Pre-PVR (n = 308) (%)	Post-PVR (n = 263) (%)	*p*-value
Gender			
Female	217 (70.5)	161 (61.2)	0.020*
Male	91 (29.5)	102(38.8)	
Mean age (years) ± SD	34.93±14.22	31.67±13.27	0.005*
Nationality			
Thais	303 (98.4)	259 (98.5)	0.992
Foreigners	5 (1.6)	4 (1.5)	
Total vaccination received			
HBV	217 (70.5)	196 (74.5)	< 0.001*
HPV	6 (1.9)	20 (7.6)	
MMR	43 (14.0)	44 (16.7)	
VAR	42 (13.6)	3 (1.1)	
Vaccines Series completion	185 (60.1)	233 (88.6)	< 0.001*
Vaccines Series adherence	170 (55.2)	226 (85.9)	< 0.001*

* Significant with *p*-value <0.05; Human Papillomavirus Vaccine: HPV, Measles-Mumps-Rubella Vaccine: MMR, Hepatitis B Vaccine: HBV, Varicella Vaccines: VAR, Personal vaccine record : PVR

Vaccine series completion and adherence rate

Seventy-seven percent of total vaccination data were 3 dose series (HBV 72 % and HPV 5%); two-dose series consisted of MMR 15% and varicella vaccine 8%. The three-dose series were accounted for more than 80% of the recipient data in the post-PVR period. The completion rate of vaccine series was significantly higher among post-PVR compared to pre-PVR (88.6% vs. 60.1 % respectively), p < 0.001. A higher proportion was also observed for adherence rate (85.9% vs. 55.2 % respectively), p < 0.001.

In univariate analysis, age>35 years and receiving vaccine post-PVR were significantly associated with vaccine series completion. When adjusted for demographics, these two factors (aOR 2.38 (95 % CI 1.52–3.75), p <0.001) and (aOR 6.52 (95 % CI 4.06–10.47), p <0.001), respectively, were independently associated with vaccine series completion (Table 3). They were also associated with adherence to vaccine series (aOR 2.65 (95 % CI 1.70–4.12), p <0.001) and (aOR 5.95 (95 % CI 3.86–9.17), p <0.001), respectively (Table 4). Moreover, 2-doses vaccine series were significantly associated with adherence in the univariate model.

Table 3 Univariate and Multivariate association of vaccines series completion among adult vaccine recipient at the Wellness Center Burapha University Hospital during 2019-2020 (N=571)

Factors *	Univariate		Multivariate	
	Crude OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
Gender				
Female	1.03 (0.70-1.52)	0.887	0.88 (0.57-1.35)	0.554
Male	1 (ref)			
Age Group				
>35 years	1.64 (1.09-2.45)	0.017*	2.38 (1.52-3.75)	< 0.001*
< 35 years	1 (ref)			
Nationality				
Thai	2.97 (0.37-23.91)	0.307	3.48(0.40-30.17)	0.258
Foreign	1 (ref)			
Post-PVR	5.16 (3.31-8.14)	< 0.001*	6.52 (4.06-10.47)	< 0.001*
Pre-PVR	1(ref)			
Type of immunization				
- 2 doses	1.41 (0.73-2.70)	0.304	0.54 (0.27-1.10)	0.091
- 3 doses	1 (ref)			

* Significant with p-value <0.05

Table 4 Univariate and Multivariate association of adherence among adult vaccine recipient at the Wellness Center Burapha University Hospital during 2019-2020 (N=571)

Factors *	Univariate		Multivariate	
	OR (95%CI)	P value	aOR (95%CI)	P value
Gender				
Female	1.04 (0.72-1.52)	0.825	0.93 (0.61-1.41)	0.733
Male	1 (ref)			
Age Group				
>35 years	1.98 (1.34-2.94)	0.001*	2.65 (1.70-4.12)	< 0.001*
< 35 years	1 (ref)			
Nationality				
Thai	0.28 (0.34-2.25)	0.230	0.19 (0.02-1.64)	0.130
Foreign	1 (ref)			
Post-PVR	4.96 (3.28-7.50)	< 0.001*	5.95 (3.86-9.17)	< 0.001*
Pre-PVR	1 (ref)			
Type of immunization				
- 2 doses	2.84 (1.53-5.25)	0.001*	1.14 (0.57-2.25)	0.714
- 3 doses	1 (ref)			

* Significant with *p*-value <0.05

Discussion

In this study, we described vaccine series completion and adherence among multi-dose vaccine recipients at the wellness center, Burapha University hospital. We demonstrated a higher proportion of vaccine series completion 88.6% and an adherence rate of 86% after the PVR was implemented. Referring to the WHO vaccine hesitancy model, the vaccine record functions as a reminder system to reduce the complexity of multi-dose vaccine series, thus promoting convenience. This has been demonstrated successfully in childhood vaccination programs worldwide.[10] Although, some dedicated adult vaccination centers are providing the vaccine record, i.e., travel clinics, the majority of adult vaccine clinics did not. We call for the wide-scale use of the adult vaccination record.

Most of the vaccine recipients in our study were Thai. It should be kept in mind that the rate of vaccine acceptance can be varied among countries and settings. Considering the WHO vaccine hesitancy model, vaccine confidence and complacency are significantly higher in Thailand comparing to the global data.[11] Thai people are likely to follow the advice of their trusted health care personnel. Local data showed that the influenza vaccine acceptance increases if the vaccine was recommended by the doctor.[12] Our study found higher vaccine completion and adherence rate among adults aged more than 35 years. Older adults might have more chances to visit the doctor. Therefore, they are more likely to concern about the vaccination schedule.

The reminder system can be varied in format. It should be made appropriate for the demographics of vaccine recipients.[13] Even with the vaccine record, we found lower vaccine series completion and adherence rate among adults aged lower than 35 years old. The vaccine record as a paperback may still be lost or forgotten. As smartphone ownership is growing rapidly in terms of number and necessity, the reminder system might be adjusted toward this trend. Electronic vaccination record or text reminder on the smartphone has been shown to increased vaccine adherence as well.[14] This format might be more appropriate among younger adults and adolescents. However, personal data protection should always be considered and consented.

There are some limitations to our study. First, during the situation of the COVID-19 pandemics, there might be other factors influencing vaccine series completion and adherence such as increasing vaccine demand, vaccine

supply shortage, and travel restriction which inhibited the hospital visit. The findings must be interpreted cautiously in regard to the situation. Second, this study used a retrospective study design, which unable to direct comparison between pre-PVR and post-PVR groups. Lastly, the study was conducted solely at the wellness center, Burapha University Hospital, the finding could be limited to generalized to every vaccination center. The reminder system should be adjusted by the demographics of vaccine recipients.

In summary, vaccine series completion and adherence were associated with the implementation of PVR in adult vaccine recipients at the wellness center, Burapha University Hospital. The completion and adherence were also associated with an adult older than 35 years. The vaccine record is one form of the reminder system which format should be individualized to settings and recipient demographics. The reminder system is not only convenient for the recipient but also for health care personnel who can review and give the most appropriate vaccine per type and schedule. We strongly advocate for the vaccine reminder system for every adult vaccination center, so that protective immunity and vaccine cost-effectiveness could be achieved.

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