

# การรับรู้และการใช้คิวอาร์โค้ดบนฉลากยาของผู้ป่วยนอกชาวไทย Perception on and Use of QR Code on Drug Labels in Thai Out-patients

นิพนธ์ต้นฉบับ

Original Article

ภัทรานี คำภูแสน<sup>1</sup> และ กรแก้ว จันทร์ภาษา<sup>2\*</sup>

<sup>1</sup> ฝ่ายเภสัชกรรม โรงพยาบาลพระอาจารย์พิน อจาโร อ.พรรณานิคม จ.สกลนคร 47130

<sup>2</sup> คณะเภสัชศาสตร์ มหาวิทยาลัยขอนแก่น อ.เมือง จ.ขอนแก่น 40002

\* Corresponding author: korch@kku.ac.th

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Pattranee Khumphusan<sup>1</sup> and Kornkaew Chanthapasa<sup>2\*</sup>

<sup>1</sup> Pharmacy Department, Arjaro Community Hospital, Phannanikhom, Sakonnakhon, 47130, Thailand

<sup>2</sup> Faculty of Pharmaceutical Sciences, Khon Kaen University, Muang, Khon Kaen, 40002, Thailand

\* Corresponding author: korch@kku.ac.th

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## บทคัดย่อ

## Abstract

**วัตถุประสงค์:** เพื่อศึกษาการรับรู้และการใช้คิวอาร์โค้ดบนฉลากยา และความสัมพันธ์ระหว่างการรับรู้และการใช้งานคิวอาร์โค้ดกับลักษณะทางประชากรศาสตร์และปัจจัยส่งเสริมการรับรู้และการใช้คิวอาร์โค้ด **วิธีการศึกษา:** การศึกษาเชิงพรรณนาโดยตัวอย่างเป็นคนไข้นอก 400 คน ณ โรงพยาบาลพระอาจารย์พินอจาโร อ.พรรณานิคม จ.สกลนคร โดยใช้แบบสอบถามข้อมูลประชากรศาสตร์ การรับรู้และการใช้คิวอาร์โค้ดบนฉลากยา (รับรู้และใช้, รับรู้แต่ไม่ได้ใช้ และไม่รับรู้) และปัจจัยส่งเสริมให้เกิดการรับรู้และการใช้งานคิวอาร์โค้ด 6 ด้าน (ประสบการณ์เดิม วิธีการค้นหาข้อมูลยาที่นิยมใช้ ความต้องการของกลุ่มตัวอย่าง การเห็นประโยชน์ของคิวอาร์โค้ดบนฉลากยา วิธีการสนใจให้เกิดการรับรู้และความสะดวกในการใช้) สุ่มตัวอย่างแบบตามความสะดวก นำเสนอข้อมูลโดยสถิติเชิงพรรณนา และทดสอบความสัมพันธ์ระหว่างการรับรู้และการใช้งานคิวอาร์โค้ดกับลักษณะทางประชากรศาสตร์และปัจจัยส่งเสริมการรับรู้และการใช้คิวอาร์โค้ดด้วยสถิติไคสแควร์ **ผลการศึกษา:** มีตัวอย่างเพียงร้อยละ 13.25 ที่มีการรับรู้และใช้งานคิวอาร์โค้ดบนฉลากยา ขณะที่ร้อยละ 44.75 รับรู้แต่ไม่ใช้งาน และร้อยละ 42.00 ไม่รับรู้เกี่ยวกับคิวอาร์โค้ด พบว่าผู้ที่อายุน้อย มีการศึกษาสูง มีอาชีพที่มีรายได้มั่นคง มีโรคประจำตัว และมียารักษาโรคที่ใช้ประจำมีการรับรู้และการใช้คิวอาร์โค้ด มากกว่าผู้ที่มีลักษณะตรงข้ามอย่างมีนัยสำคัญทางสถิติ ( $P$ -value < 0.05) คุณสมบัติด้านบวกของปัจจัยส่งเสริม ทั้ง 6 ปัจจัยสัมพันธ์กับการรับรู้และการใช้คิวอาร์โค้ด มากกว่าผู้ที่มีลักษณะตรงข้ามอย่างมีนัยสำคัญทางสถิติ ( $P$ -value < 0.05) **สรุป:** ผู้ที่อายุน้อย มีการศึกษาสูง มีอาชีพที่มีรายได้มั่นคง มีโรคประจำตัวและยาที่รักษาโรคประจำตัว และผู้ที่มีลักษณะเชิงบวกของปัจจัยส่งเสริม มีแนวโน้มที่จะรับรู้และใช้งานคิวอาร์โค้ดมากกว่าผู้ที่มีลักษณะตรงข้าม

**คำสำคัญ:** การรับรู้, การใช้งาน, คิวอาร์โค้ด, ฉลากยา, ปัจจัยส่งเสริม

**Objective:** To determine levels of perception on and use of QR code on drug labels and its association with demographic characteristics and facilitating factors. **Method:** In this descriptive study, we recruited 400 out-patients at Arjaro Community Hospital, Phannanikhom, Sakonnakhon, Thailand. We used questionnaire to ask participant their demographic characteristics, perception on and use of QR code (perceived and used, perceived but not used, and not perceived the QR code), and 6 main facilitating factors to perception on and use of QR code (past experience, preference on drug information search, the needs for QR code, perceived usefulness of QR code, motivation to perception, and ease of use of QR code). Data were presented with descriptive statistics. Associations between perception on and use of QR code on drug labels and with demographic characteristics and facilitating factors were tested using chi-square test. **Results:** Only 13.25% of participants perceived and used QR code on drug labels, while 44.75% perceived but did not use, and 42.00% did not perceive the QR code. Those who were younger, had high education level, had secure job and monthly income, had chronic illnesses and medications for chronic illnesses were more likely to perceive and use QR code than their counterparts with statistical significance ( $P$ -value < 0.05). Positive attribute of each individual factors of the 6 main factors was associated with perceiving and using QR code than their counterparts with statistical significance ( $P$ -value < 0.05). **Conclusion:** Participants who were younger, had high education level, had secure job and monthly income, had chronic illnesses, had medications for chronic illnesses, and had positive attributes of facilitating factors were more likely to perceive and use QR code on drug labels than their counterparts.

**Keywords:** perception, perception, use, QR code, drug labels, facilitating factors

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## Introduction

Thailand has been moving to the new society called Thailand 4.0. In this digital society, creativity, technology, and innovation are the main features.<sup>1</sup> The Ministry of Public Health (MoPH) has been implementing health information technology system for the nationwide healthcare system. One of the effort is the Smart Hospital project which aims to enhance health service quality by implementing innovative digital technology for a proactive health service. This kind of

technology could provide a quality, fast service to better satisfy the patients.<sup>2</sup>

One of the well-known digital technology projects of the Ministry of Public Health is a smartphone application software called "RDU-drug experts." The application provides information of given drugs through smartphones by scanning the standard QR code on the drug label distributed to all hospitals under the provision of the MoPH.<sup>3</sup> This application

is one of the latest products of the project entitled "Rational Drug Use Hospital" or RDU Hospital which promotes the creation and dissemination of standard drug labels, auxiliary labels, and related drug information, such as patient information leaflets, to the public.<sup>4</sup>

This innovation using the quick response code or QR code has been used to replace the old, usual way of provide drug information on the label. Such traditional labels are small and jammed with small-font print of drug information. Even the auxiliary labels to provide additional drug information are small and packed with small letters of drug information. As a result, these drug labels and auxiliary labels are almost unreadable. These auxiliary labels are prone to loss since they are put in the plastic bag with no adhesives and they are relatively costly. The transformation of drug information into the QR code was easy technically with almost no cost. The code is digitally readable even though the code printout is damaged, dirty or sloughed off. The small size of QR code does not limit the large amount of information to provide the clients.<sup>5</sup> QR code could also provide other additional drug information including drugs with special techniques, and the use of drugs special groups of patients such as the elderly, children, and patients with kidney and/or liver impairments. Another advantage of QR code is its versatile applications. For example, it can be applied to provide voice drug labels for the elderly or visually impaired patients.<sup>6</sup>

Previous research revealed that QR code has been used in healthcare service in many countries. In Taiwan, the QR Code Prescription has been used for communicating information of the patient's medical and drug data to drugstores to enhance effective communication between the two settings resulting in correct, precise patient data shared and ultimately fewer medication errors.<sup>7</sup> There has been a system on Cloud data system using QR code with website service to enhance safe drug use in the elderly with chronic illnesses.<sup>8</sup> In Singapore, Japan, and Hongkong, QR code has been applied on a wristband for in-patients to help identify the patient with higher precision and to better access to the patient's medical history database using their name, ID number, date of birth, and room and bed number.<sup>9</sup> In Turkey, QR code has been implemented in the Identity Tag System of which the patient has QR code as an ID card worn as necklace or wristband all the time almost like the jewelry or when to use healthcare service.<sup>10</sup> In England, QR code has been used in communicating drug information and treatment

guidelines for complications in cancer patients receiving immunotherapy in the hospital with no acute oncology team.<sup>11</sup> QR code is printed on the patient ID card which could alert the physician to access the patient's medical and medication history and guidelines to manage drugs' complications in a timely, correct fashion.<sup>11</sup>

The success in application of QR code in healthcare system does not depend solely on its technical feasibility, but various human factors as well. Various research revealed that perception on and use of QR code are affected by personal factors including age<sup>12</sup>, occupation<sup>13</sup> and income.<sup>12,13</sup> In addition, perception on and use of QR code are dependent on various perception facilitating factors such as perceived value, needs, past experience, compatibility, perceived usefulness, playfulness<sup>13</sup>, ease of use<sup>12,13</sup> and work facilitation.<sup>12</sup>

QR code has been increasingly used in healthcare information communication. It has been used to communicate drug information of specific patients and guidelines for clinical drug management. However, based on the experience of various countries, the use of QR code has been mostly for communication among healthcare providers while communication between the providers and patients has been relatively limited. In Thailand, however, QR code is used to communicate drug information from the provider to the patient in a project called Smart Hospital together with the RDU Hospital project with the goal of all hospitals nationwide having QR code on drug labels.<sup>2</sup> However, different parts of the country have adopted the policy differently and worth separate investigations.

In Sakonkakhon province, all 18 hospitals under the MoPH have adopted the Smart Hospital and RDU Hospital policies by having QR code on drug labels since 2019.<sup>14</sup> Certain outcomes regarding the patient's perception have been found to be limited. For example, in a pilot study at Arjaro Community Hospital, of 28 patients surveyed, only 15 perceived the QR code on drug labels (54%). This suggested that QR code was disappointingly perceived by a relatively low portion of the patients considering a 2-year policy adoption. However, the result could have been biased because of a small sample. A larger study to determine the patient's perception on QR code was needed. In addition, the actual use of the QR code and factors affecting the perception on and use of the QR code should be determined. Findings could be used to improve the QR code for more convenient use. This study aimed to determine perception and actual use of

the QR code on drug labels, and associations between perception and actual use of the QR code and demographic characteristics and facilitating factors of the perception and actual use of the QR code. Perception on the QR code on drug labels was defined as the patient's understanding that the QR code was meant to provide drug information by means of smartphone scanning and the information was provided in addition to that on the actual drug label. Specifically, we hypothesized that patients with different demographic characteristics (i.e., gender, age, education level, occupation, monthly income, number of chronic illnesses, and medications for their chronic illnesses) had different perception on and use of QR code. For perception facilitating factors, we hypothesized that perception on and use of QR code were different with differences in past experience, preference on drug information search, needs for QR code, perceived usefulness of QR code on drug labels, motivation to perception, and ease of use of the QR code.

## Methods

In this descriptive cross-sectional study, two data collections were conducted because of the disruption caused by covid-19 pandemic. The first data collection was done from November 2019 to January 2020, and the second collection was from July to September, 2020. The study was approved by the Ethics Committee for Human Studies of Khonkaen University (approval number: HE622160, approval date: August 2, 2020). Study population was 34,304 patients who had been receiving care at the outpatient department of Arjaro Community Hospital for at least 3 years from 2016 to 2018. Our pilot study in 28 patients found that 15 of them (54% or  $p = 0.54$ ) perceived the objective and use of QR code on drug labels. The sample size was estimated with the following equation.

$$n' = \frac{NZ_{\alpha/2}^2 p(1-p)}{e^2 N + Z_{\alpha/2}^2 p(1-p)}$$

With a study population (N) of 34,304 patients, sampling error (e) of 0.05, Z corresponding to a type I error of 5% (two-sided) of 1.96, and a proportion of interested attribute of 0.54, a sample size (n') of 378 was required. We selected 400 patients by convenience sampling method. To be eligible, they had to receive care at the outpatient department, be 18 – 60 years old, and have perfect consciousness to communicate in Thai language. We excluded patients who had psychiatric

problems, required emergency medical attention, participated in the pilot study, or were not willing to participate.

### Research instruments

Questionnaire was used to collect data. The first part collected demographic characteristics of the participants including gender, age, education level, occupation, monthly income, chronic illnesses, and medications for their chronic illnesses. The second part asked about perceptions and use of QR code on drug labels with a single question. The response to the statement on the perception on and use of QR code on drug labels was classified into three levels. The first level was "perceived and used it." Specifically, "perceived it" meant the participant acknowledge the presence of the QR code on the drug labels was the channel to obtain drug use information and "used it" meant that they scanned the QR code to see drug use information at least once. The second level was "perceived but never used it" of which the participant never scanned the QR code for drug use information despite perceiving the QR code as the channel to obtain drug use information. The last level was "not perceived" which meant the participant did not perceive that the QR code was the channel to obtain drug use information.

The last part asked about factors facilitating the perception on and use of QR code. Six main factors with their respective individual factors were as follows. For the first main factor of past experience, the participants were asked whether they had seen QR code before, had conducted any financial transaction or purchased merchandise or accessed website by QR code scan before, and had received medications with QR code on the label before. For the second main factor of preference on drug information search, the participants were asked whether they preferred online or offline search. Online search included scanning QR code on labels and Internet search; while offline search included reading auxiliary labels, asking healthcare providers, and asking friends or family members. For the third main factor of needs for QR code on drug labels, the participants were asked whether they needed QR code on drug labels and whether they needed to learn how to use QR code on drug labels. For the fourth main factor of perceived usefulness of QR code on drug labels, the participants were asked whether they perceived the usefulness of easy and fast access to drug information by QR code on drug labels, and interesting communication of drug information by QR code on drug labels. For the fifth main factor of motivation to perceive

QR code on drug labels, the participants were asked whether they had heard about public announcement on QR code use, had seen public relation sign about QR code use, and had received advice about QR code from pharmacist while given drugs, and had received advice about QR code from people. For the sixth main factor of ease of use of QR code on drug labels, the participants were asked whether they had smartphone with the Internet connection and had applications on smartphone to scan QR QR code. Response for each individual factor was in a yes-no format.

### Instrument quality assurance

Content validity was examined by three experts, specifically, two instructors in social and administrative pharmacy, the Faculty of Pharmaceutical Sciences, Khonkaen University, and a member of the committee for patient information leaflet development, Food and Drug Administration, MoPH who was also an instructor in pharmaceutical care department of the Faculty of Pharmaceutical Sciences, Khonkaen University. The experts approved all questions as reflecting the study objectives. Suggestions were taken for questionnaire revision.

### Data collection procedure

The researcher (P. Khumphusan) collected data at the outpatient department of Arjaro Community Hospital from 7.30 – 9.00 AM while the patients were waiting for office visit with the physician. The researcher provided details about study objectives, process, and risk and benefits of participation. With the voluntary nature of the study, participants were not forced to participate and could withdraw from the study at any time with no consequences on the care they would receive in the future. Once written informed consent was obtained, the researcher asked the participant to self-administer the questionnaire which took about 30 minutes to complete.

### Statistical data analysis

Descriptive statistics including mean with standard deviation (SD) and frequency with percentage were used to present demographic characteristics, perception on and use of QR code on drug labels and each of the facilitating factors. Associations between perception on and use of QR code and demographic characteristics and facilitating factors were tested using chi-square test or Fisher's exact test, as appropriate. Statistical significance was set at a type I error of 5% or *P*-value

< 0.05. All statistical analyses were conducted using software program SPSS version 26.

## Results

Majority of the participants were women (74.75%), in their 41 – 50 years of age (29.25%), with senior high school education or primary vocational school education (28.00%), in agriculture (41.00%), with monthly income of 5,000 Baht or lower (44.25%), with no chronic illnesses (63.50%), and with no medications for chronic illnesses (65.25%) (Table 1).

**Table 1** Demographic and health status characteristics (N = 400).

Characteristics	N (%)
<b>Gender</b>	
Men	101 (25.25)
Women	299 (74.75)
<b>Age (years)</b>	
< 30	86 (21.50)
30 - 40	94 (23.50)
41 - 50	117 (29.25)
51 - 60	103 (25.75)
<b>Educational level</b>	
Primary school	100 (25.00)
Junior high school level	53 (13.25)
Senior high school or primary vocational school	112 (28.00)
Secondary vocational school or associate degree	46 (11.50)
Bachelor's degree or higher	89 (22.25)
<b>Occupation</b>	
Agriculture	164 (41.00)
Government employees	69 (24.00)
Business	60 (15.00)
No job	45 (11.25)
Students and others	35 (8.75)
<b>Monthly income (Baht)</b>	
≤ 5,000	117 (44.25)
5,001 – 10,000	100 (25.00)
10,001 – 15,000	70 (17.50)
15,001 or higher	53 (13.25)
<b>Chronic illnesses</b>	
No	254 (63.50)
Yes	146 (36.50)
<b>Medications for chronic illnesses</b>	
No	261 (65.25)
Yes	139 (34.75)

It was found that most participants perceived but did not use QR code on drug labels (44.75%); while 42.00% did not perceive the QR code (Table 2). There was a small portion of participants (13.25%) that perceived and used the QR code.

**Table 2** Perception on and use of QR code on drug labels (N = 400).

Perception on and use of QR code	N (%)
Perceived and used it	53 (13.25)
Perceived but did not use it	179 (44.75)
Did not perceive it	168 (42.75)

### Associations between demographic characteristics and perception on and use of QR code on drug labels

Most demographic characteristics, except gender, were significantly associated with perception on and use of QR code on drug labels (Table 3). Age was associated with level of perception on and use of QR code with statistical significance ( $P$ -value < 0.001). Specifically, among those younger than 30 years old 76.74% perceived the QR code (22.09% used it and 54.65% did not use it), while only 23.26% did not perceive it. In contrast, among those 51 – 60 years old, as high as 59.22% of them did not perceive the QR code. Education was associated with level of perception on and use of QR code with statistical significance ( $P$ -value < 0.001) where those with primary school was more likely to not perceive the QR code (61.00%) while those with Bachelor's degree or higher were more likely to perceive the QR code and either to use (22.47%) or not to use it (51.69%).

Different occupations had different likelihood of perception on and use of QR code ( $P$ -value < 0.001). Participants who had no jobs were more likely to not recognize the QR code (54.88%) while those who were government employees (30.00%) and students and others (25.71%) were least likely to do so.

Differences in monthly incomes were associated with different likelihood of perception on and use of QR code ( $P$ -value = 0.013). Participants who had a monthly income of 15,001 Baht or higher were more likely to perceive and use QR code (22.64%) compared with those with a monthly income of 5,000 Baht or lower (7.34%). A larger proportion of participants with chronic illnesses did not perceive QR code (56.68%) while a smaller proportion of those with no chronic illnesses did so (37.01%) ( $P$ -value = 0.028). Similar pattern was found with participants with and without medications for chronic illnesses ( $P$ -value = 0.027).

**Table 3** Associations between demographic characteristics and perception on and use of QR code (N = 400).

Participants	N (%) by level of perception			Total (N = 400)	P-value*
	Perceived and used it (n = 53)	Perceived but did not use it (n = 179)	Did not perceive it (n = 168)		
<b>Gender</b>					0.154
Men	19 (18.81)	41 (40.59)	41 (40.59)	101 (100.00)	
Women	34 (11.37)	138 (46.15)	127 (42.47)	299 (100.00)	
<b>Age (years)</b>					< 0.001
< 30	19 (22.09)	47 (54.65)	20 (23.26)	86 (100.00)	
30 - 40	14 (14.89)	46 (48.94)	34 (36.17)	94 (100.00)	
41 - 50	8 (6.84)	56 (47.86)	53 (45.30)	117 (100.00)	
51 – 60	12 (11.65)	30 (29.13)	61 (59.22)	103 (100.00)	
<b>Educaton level</b>					< 0.001
Primary school	5 (5.00)	34 (34.00)	61 (61.00)	100 (100.00)	
Junior high school level	6 (11.32)	27 (50.94)	20 (37.74)	53 (100.00)	
Senior high school or primary vocational school	16 (14.29)	53 (47.32)	43 (38.39)	112 (100.00)	
Secondary vocational school or associate degree	6 (13.04)	19 (41.30)	21 (45.65)	46 (100.00)	
Bachelor's degree or higher	20 (22.47)	46 (51.69)	23 (25.84)	89 (100.00)	
<b>Occupation</b>					< 0.001
Agriculture	21 (21.88)	43 (44.79)	32 (33.33)	96 (100.00)	
Government employees	12 (20.00)	30 (50.00)	18 (30.00)	60 (100.00)	
Business	8 (17.78)	18 (40.00)	19 (42.22)	45 (100.00)	
No job	8 (4.88)	66 (40.24)	90 (54.88)	164 (100.00)	
Students and others	4 (1.43)	22 (62.86)	9 (25.71)	35 (100.00)	
<b>Monthly income (Baht)</b>					0.013
≤ 5,000	13 (7.34)	75 (42.37)	89 (50.28)	177 (100.00)	
5,001 – 10,000	16 (16.00)	45 (45.00)	39 (39.00)	100 (100.00)	
10,001 – 15,000	12 (17.14)	33 (47.14)	25 (35.71)	70 (100.00)	
15,001 or higher	12 (22.64)	26 (49.06)	15 (28.30)	53 (100.00)	
<b>Chronic illnesses</b>					0.028
No	37 (14.57)	123 (48.43)	94 (37.01)	254 (100.00)	
Yes	16 (10.96)	56 (38.36)	74 (56.68)	146 (100.00)	
<b>Medications for chronic illnesses</b>					0.027
No	37 (14.18)	127 (48.66)	97 (37.16)	261 (100.00)	
Yes	16 (11.51)	52 (37.41)	71 (51.08)	139 (100.00)	

\* Chi-square test.

## Associations between facilitating factors and perception on and use of QR code on drug labels

Most of individual factors under the 6 main factors were significantly associated with perception on and use of QR

code (Table 4). For the main factor of past experience, participants who saw or knew about QR code before, who conducted financial transaction or purchased merchandise or accessed website by QR code scan, and who received medications with QR code on the label were more likely to

**Table 4** Associations between facilitating factors and perception on and use of QR code (N = 400).

Facilitating factors	N (%) by level of perception			Total (N = 400)	P-value*
	Perceived and used it (n = 53)	Perceived but did not use it (n = 179)	Did not perceive it (n = 168)		
<b>1. Past experience</b>					
<b>Having seen QR code before</b>					
Yes	53 (15.73)	165 (48.96)	119 (35.31)	337 (100.00)	< 0.001
No	0 (0.00)	14 (22.22)	49 (77.78)	63 (100.00)	
<b>Having conducted financial transaction or purchased merchandise or accessed website by QR code scan</b>					
Yes	40 (25.64)	75 (48.08)	41 (26.28)	156 (100.00)	< 0.001
No	13 (5.33)	104 (42.62)	127 (52.05)	244 (100.00)	
<b>Having received medications with QR code on the label</b>					
Yes	40 (21.62)	87 (47.03)	58 (31.35)	185 (100.00)	< 0.001
No	13 (6.05)	92 (42.79)	110 (51.16)	215 (100.00)	
<b>2. Preference on drug information search</b>					
<b>Online search</b>					
Scanning QR code on labels	27 (20.45)	67 (50.76)	38 (28.79)	132(100.00)	< 0.001
Internet search	6 (26.09)	17 (73.91)	0 (0.00)	23 (100.00)	
Offline search	21 (19.27)	50 (45.87)	38 (34.86)	109 (100.00)	
<b>Offline search</b>					
Reading auxiliary labels	26 (9.70)	112 (41.79)	130 (48.51)	268(100.00)	< 0.001
Asking healthcare providers	20 (10.20)	84 (42.86)	92 (46.94)	196 (100.00)	
Asking friends or family members	6 (8.82)	27 (39.71)	35 (51.47)	68 (100.00)	
	0 (0.00)	1 (25.00)	3 (75.00)	4 (100.00)	
<b>3. Needs for QR code on drug labels</b>					
<b>Need for QR code on drug labels</b>					
Yes	53 (14.93)	161 (45.35)	141 (39.72)	355 (100.00)	0.004
No	0 (0.00)	18 (40.00)	27 (60.00)	45 (100.00)	
<b>Need to learn how to use QR code on drug labels</b>					
Yes	46 (13.45)	155 (45.32)	141 (41.23)	342 (100.00)	0.749
No	7 (12.07)	24 (41.38)	27 (46.55)	58 (100.00)	
<b>4. Perceived usefulness of OQ code on drug labels</b>					
<b>Easy access to drug information by QR code on drug labels</b>					
Yes	51 (19.77)	144 (55.81)	63 (24.42)	258 (100.00)	< 0.001
No, or not known	2 (1.41)	35 (24.65)	105 (73.94)	142 (100.00)	
<b>Fast access to drug information by QR code on drug labels</b>					
Yes	51 (17.96)	155 (54.58)	78 (27.46)	284 (100.00)	0.001
No, or not known	2 (1.72)	24 (20.69)	90 (77.59)	116 (100.00)	
<b>Interesting communication of drug information by QR code on drug labels</b>					
Yes	49 (16.90)	154 (53.10)	87 (30.00)	290 (100.00)	< 0.001
No, or not known	4 (3.64)	25 (22.73)	81 (73.64)	110 (100.00)	
<b>5. Motivation to perceive QR code on drug labels</b>					
<b>Having heard about public relation on QR code use</b>					
Yes	27 (19.15)	76 (53.90)	38 (26.95)	141 (100.00)	< 0.001
No	26 (10.04)	103 (39.77)	130 (50.19)	259 (100.00)	
<b>Having seen public relation sign about QR code use</b>					
Yes	37 (19.68)	104 (55.32)	47 (25.00)	188 (100.00)	< 0.001
No	16 (7.55)	75 (35.38)	121 (57.08)	212 (100.00)	
<b>Having received advice about QR code from pharmacist while given drugs</b>					
Yes	30 (27.52)	55 (50.46)	24 (22.02)	109 (100.00)	< 0.001
No	23 (7.90)	124 (42.61)	144 (49.48)	291 (100.00)	
<b>Having received advice about QR code from people</b>					
Yes	32 (30.77)	53 (50.96)	19 (18.27)	104 (100.00)	< 0.001
No	21 (7.09)	126 (42.57)	149 (50.34)	296 (100.00)	
<b>6. Ease of use of QR code on drug labels</b>					
<b>Having smartphone with the Internet connection</b>					
Yes	53 (15.23)	169 (48.56)	126 (36.21)	348 (100.00)	< 0.001
No	0 (0.00)	10 (19.23)	42 (80.77)	52 (100.00)	
<b>Having applications on smartphone to scan QR QR code</b>					
Yes	53 (18.73)	140 (49.47)	90 (31.80)	283 (100.00)	< 0.001
No	0 (0.00)	39 (33.33)	78 (66.67)	117 (100.00)	

\* Chi-square test.

perceive and use the QR code than those who did not ( $P$ -value  $< 0.001$  for all three individual indicators). However, it was worth noting that more than half of the participants never received medications with QR code on the label (215 out of 400 patients).

For preferred mode of drug information search, participants preferring online search were more likely to perceive and use the QR code than those preferring offline search ( $P$ -value  $< 0.001$ ). Among those preferring online search, the majority were those who perceived but did not use the QR code. However, more than half of participants were those who preferred offline search (268 out of 400 patients), including asking for drug information from healthcare providers and reading the information on the auxiliary labels.

For the main factor of the participant's need, participants who wanted QR code on labels were more likely to perceive and use of QR code than those who did not ( $P$ -value = 0.004). However, there was no difference about perception on and use of QR code among participants who wanted and did not want to learn how to use QR code on drug labels. In terms of perceived usefulness of the QR code on drug labels, it was clear that participants who agreed that QR code provided easy access to drug information, fast access to drug information, and interesting communication of drug information, were more likely to perceive and use the QR code on drug labels than those who did not ( $P$ -value  $< 0.001$  for all three individual factors). However, most of them classified themselves as perceiving but not using the QR code.

For the main factor of motivation to perception, participants who heard about public relation on QR code use, saw public relation sign about QR code use, received advice about QR code from pharmacist while given drugs, and received advice about QR code from people were more likely to perceive and use QR code than those who did not ( $P$ -value  $< 0.001$  for all four individual factors). However, most of them classified themselves as perceiving but not using the QR code. In addition, more than half of all participants never received information or advice about the QR code on drug labels.

In terms of ease of use of the QR code, participants who had smartphone to connect to the Internet and who had smartphone with applications to scan QR code were more likely to perceive and use the QR code on drug labels ( $P$ -value  $< 0.001$  for both individual factors). Among participants

with the Internet connection and applications to scan QR code, most of them perceived but did not use the QR code. As expected, most participants had the Internet connection and applications to scan QR code on their smartphones (Table 4).

## Discussions and Conclusion

In our survey study, only 13.25% of the participants reported that they perceived and used QR code on drug labels. In examining associations between various facilitating factors and the perception on and use of QR code on drug labels, participants possessing positive attributes of each individual factor of the six main factors including past experience, preference on drug information search, needs for the use of QR code, perceived usefulness of QR code, motivation for perception on QR code, and ease of use of QR code were more likely to have perception on and use of QR code on drug labels with statistical significance ( $P$ -value  $< 0.05$ ).

Despite a small proportion of participants (13.25%) reporting perception on and use of QR code on drug labels, these participants were ready to use QR code on the labels. This could be attributable to their past experience of having seen the QR code, having the drive to learn and to have QR code on drug labels, and realizing the benefits of QR code for fast and easy access to and interesting communication of drug information. In addition, most participants had smartphone with the Internet connection and with QR code scanner applications, this facilitating factor could have helped them perceive and use the QR code on drug labels.

We found that as high as 42.00% of the participant did not perceive the presence of QR code on drug labels at all. This was consistent with our pilot study which found that 46.00% of participants perceived no QR code. We found that these participants were those who lacked motivation to perceive the QR code. Specifically, more than half of them had never heard of public announcement on QR code, had never seen QR campaign sign, and had never been advised about QR code on drug labels from healthcare providers. These attributes could make them less motivated to perceive the presence of QR code. The less perception on the QR code could lead to a less chance to use the code.

For participants who perceived and but did not use QR code on drug labels which was the largest group of the sample

(44.75%), they represented people who did not use any tools to use QR code either the Internet connection or QR code scanner applications on their smartphones. About two-thirds of them (268 out of 400 participants) preferred offline drug information to the online one. The use of QR code could not be fully widely visible since not all drug items were provided with the QR code. At present, the RDU Hospital project has developed QR code for only 13 groups of drugs including paracetamol, paracetamol combination, nonsteroidal anti-inflammatory drugs (NSAIDs), non-sedative antihistamines, antibiotics, domperidone, ACE Inhibitors, calcium channel blockers, metformin, sulfonylureas, statins, colchicine and allopurinol.<sup>15</sup> If these participants were prescribed any medications out of this list, they would have missed opportunity to use the QR code on drug labels. Even though the QR code was perceived but somehow it could be inadequate to set a strong perception.

It was worth noting that 7 groups of the drugs with QR code were those for chronic illnesses. Patients with chronic illnesses were familiar with their regular medications. They did not pay much attention on seeking drug information either with or without QR code since they have used their medications for a long time with no problems. This was evident as 38.36% of participants had chronic illnesses and 56.68% of them did not perceive the QR code on drug labels. To promote the perception on and use of QR code, additional promotion campaigns should be in place and QR codes for all drug items should be created. The more exposure to QR code could enhance more perception and ultimately more acceptance. The acceptance on QR code on drug labels could allow for applications in more medical services. In other countries, QR code has been widely in healthcare system. For example, QR code is used to share the patient's medical and medication information between two hospitals and between hospitals and drugstores<sup>7</sup>, to promote the safe drug use among the elderly patients with chronic illnesses<sup>8</sup>, to help better identify hospitalized patients with QR code bearing wristband<sup>9</sup>, and to have QR code as ID instead of the traditional patient ID card when receiving care at the hospital.<sup>10</sup> The application of QR code to achieve effective, precise and reliable communication in medical service is relatively limitless.

For the associations between the perception on and use of QR code on drug labels and various demographic characteristics, it was found that differences in most characteristics (age, education, occupation, monthly income,

having chronic illnesses, and having medications for chronic illnesses) except gender, were significantly associated with different levels of perception and use ( $P$ -value < 0.05). Our findings were consistent with certain previous research<sup>12,13</sup> with certain exceptions in Pollawan et al that education and occupation were not associated with the use of QR code.<sup>12</sup> This discrepancy could be attributable to differences in context of study populations, sample characteristics make-up, and the use of QR code. In our study, patients with the use of QR code on drug labels were studied. On the other hand, Wongthongchai et al<sup>13</sup> studied general use of QR code in people in generation Y, and Pollawan et al<sup>12</sup> studied general use of QR code in general population in Bangkok metropolis area. It is evident that previous studies emphasized the general use of QR code, not specifically the ones on drug labels. Therefore more studies on the use of QR code on drug labels should be more available to promote its wider use.

With a limited number of studies in the elderly population, more studies on the elderly should be conducted to better manage the large number of medications for their chronic illnesses. Even though our study showed that participants aged 51 – 60 years old were the least likely to perceive the QR code on drug labels, it could not be definitely concluded that the elderly were the ones who rejected technology the most. In the survey in 2020, Thai baby boomers (i.e., those aged 56 – 74 years old) used the Internet as high as 8 hours 41 minutes per day.<sup>16</sup> The survey also found that Thai baby boomers have increased their Internet use every year, especially the online information search of 76% increase.<sup>16</sup> This indicates that the elderly are interested to learn and adopt new technology and therefore older age is not the obstacle for technology adoption for daily life. We proposed more studies on the use of new technology on the elderly because they have to manage a large number of medications for their chronic illnesses.

Our study had certain limitations. First, with the covid-19 pandemic, a large number of patients were told to stay home and their medications were delivered to their houses. As a result, a large portion of the elderly patients with many chronic illnesses and related medications were missed in our sample. A picture of their drug related problems in association with their perception of the QR code on drug labels was not well captured. More studies on the elderly patients on the QR code use in relation to their drug related problems in normal situations should be conducted. In addition, since this sample



was obtained by a convenience sampling method, representativeness of the study population was somewhat limited. Future studies with simple random sampling should be conducted.

In conclusion, participants with younger age, higher education level, and secure occupation with higher monthly income were more likely to perceive and use QR code on drug labels. Most participants were ready to use QR code on drug labels because of their past experience, their needs to learn and have QR code on drug labels, their perceived usefulness of the QR code, and availability of tools to use the QR code on drug labels. More promotion on the use of QR code on drug labels and availability of QR code for all drug items could help enhance the perception on and use of the QR code on drug labels.

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