Physician-and patient-reported barriers to hepatocellular carcinoma surveillance: a nationwide survey

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Research

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Abstract

Background Hepatocellular carcinoma (HCC) surveillance rates are suboptimal. We aimed to identify HCC surveillance barriers from both physician and patient perspectives and assess the effectiveness of physician education using social networks.

Methods A nationwide survey with 513 physicians and another single-center survey with 315 HCC-risk patients were conducted. Regression analysis was used to identify surveillance barriers. We educated 143 physicians by sending brief notes on HCC surveillance guidelines via social networks and re-evaluated their knowledge at 60 days using paired T-test.

Results Surveys showed 458 (86.3%), 254 (47.8%) and 225 (42.4%) physicians recommended surveillance in patients with cirrhosis, at-risk HBV and HCV infection, respectively. Only 228 (42.9%) and 241 (38.0%) respondents adhered to recommended surveillance tools and interval, respectively. The main surveillance barriers among physicians were the lack of knowledge and resource limitations. The lack of a doctor's prescription was identified as main barrier by patients (relative risk 1.4, 95%CI 1.1-1.8, p=0.024). Social networks education enhanced physicians' knowledge pre-and post-education scores for guideline awareness: (63.0%vs.84.3%, p<0.001) and surveillance indication (40.0%vs.63.0%, p=0.001).

Conclusions Physicians' knowledge gap was primary barrier for adherence to HCC surveillance protocols. Brief education via social networks showed effectiveness at increasing knowledge of HCC surveillance with medical residents.

Clinical trial registry: This study was registered to the Thai clinical trial registry (TCTR number 20210127006). Registered 22 July 2021- Retrospectively registered. http://www.clinicaltrials.in.th/

Introduction

Hepatocellular carcinoma (HCC) is one of the leading causes of cancer-related death worldwide. The prognosis of HCC patients primarily depends on the tumor stage at diagnosis. HCC surveillance has been shown to improve early detection of HCC[1]. Current international HCC guidelines recommend HCC surveillance using ultrasound (US) with or without serum alpha-fetoprotein (AFP) test every 6 months in patients at high-risk for developing HCC[2, 3]. Despite these well-known benefits, recent meta-analysis revealed that HCC surveillance remained suboptimal with wide variety among countries, ranging from 18.4%-42% in the United States[4], 23.1% in Thailand[5], and 70% in select European countries[6]. Therefore, we aimed to determine barriers of HCC surveillance among both physician and patient perspectives and assess efficacy of a brief HCC surveillance educational intervention for physicians disseminated via social network platforms.

Methods

Study design

This study was conducted in two phases from July 2016 to February 2019 (**Figure 1**). In Phase 1, we evaluated barriers to HCC surveillance based on physician and patient perspectives using questionnaires created specifically for the study. In Phase 2, we created a simple educational tool for providing knowledge of HCC surveillance to physicians. The knowledge content of the tool was developed based on the results of Phase 1. Subsequently, we conducted a prospective interventional study to evaluate the effectiveness of the developed tool on improving physicians' knowledge of HCC surveillance.

Study cohorts

Phase 1: Survey of barriers to HCC surveillance

1. Physician perspectives

Our primary outcome was to identify physician and patient-based barriers to non-adherence to Thailand's 2015 national guidelines endorsed by the Thai Association for the Study of the Liver (THASL). The guidelines recommend HCC surveillance for high-risk patients with the following conditions: 1) cirrhosis from any causes, 2) chronic hepatitis B virus (HBV) infection in males with age ≥ 40 years or females with age ≥ 50 year, 3) Chronic HBV infected patients with a history of HCC in the first-degree relatives, and 4) chronic hepatitis C virus (HCV) infection with ≥F3 fibrosis. Upper abdominal US is recommended as the main surveillance tool or in combination with serum AFP test every 6-12 months.

We performed a nationwide survey of physicians working at different hospital levels (community, general, and academic centers) located in all geographic regions of Thailand (57 of 77 provinces). Physicians with different areas of expertise (i.e. general practitioners (GPs), internal medicine residents, internists and gastroenterologists) were invited to participate in the study. Eligibility was limited to physicians who reported seeing at least 1 high-risk HCC patient weekly. We excluded providers who were retired, worked full-time in private hospitals, or those whose major professional activities were research.

We developed questionnaires to assess 4 primary domains: 1) surveillance knowledge, which comprised of "knowing" the recommendations (indication, tools and intervals) and "understanding" the recommendations (scenario-based questions), 2) attitudes toward surveillance, 3) physician practice pattern, and 4) opinions about surveillance barriers including physician factors and healthcare system factors. The questionnaires were pilot-tested on 10 internists and 10 medicine residents to ensure comprehension. Reliability testing was also performed with 20 physicians using the test-retest method and revealed that the vast majority of the questions (90%) were properly understood (median agreement 80%). The final version of the questionnaires was modified based on the pre-test results. It was determined that each questionnaire took approximately 10 minutes to complete. **(Supplemental document 1)**

2. Patient perspectives

Patients with a high risk for developing HCC who were followed up at the liver clinic at Chulalongkorn Hospital, Thailand were screened. We excluded patients with a follow-up time of less than 24 months,

and those diagnosed with HCC. The patient questionnaire was designed by the study investigators and later adjusted after a pilot test with patients. The questionnaires consisted of 4 sections: 1) patient demographics, 2) HCC knowledge (risk of HCC, optimal tool(s) and interval for surveillance), 3) attitudes towards HCC surveillance, and 4) opinions about barriers (personal, physician, and system) to inadequate surveillance. **(Supplemental document 2)**

Phase 2: Improving HCC surveillance knowledge by brief educational tool

We created a brief knowledge card which is comprised of indications, tools and interval protocols for HCC surveillance based on the 2015 THASL guidelines. (**Figure 2**) The card was personally disseminated to all internal medicine residents (n=108) from Phase 1 study through Facebook and LINE, which is an instant messaging app used on smart phones, tablets and computers that is universally used in everyday life. The card took approximately 2-3 minutes to read. All residents were asked to notify investigators after they have read the card. Participants could freely download the card and kept in their personal devices and read anytime they want but they were requested not to read it during re-test. After 60 days, we re-evaluated their knowledge using the Phase I questionnaire.

Statistical analysis

In phase 1, a systematic, stratified random sampling was designed to identify the physician sample population. We randomly chose 70% of provinces in each of the 6 regions of Thailand. From each selected province, we calculated the number of hospitals and physicians per population ratio based on information from the Ministry of Public Health to estimate sample size needed per province. Because the number of ambulatory visits and the number of physicians in secondary/tertiary hospitals in each province is approximately twice as those in community hospitals, we distributed questionnaires to physicians from community hospitals and secondary/tertiary hospitals with a ratio of 2:1 corresponding to the number of ambulatory visits and the number of physicians in each hospital level.[7,8]

To identify patients' barriers to HCC surveillance, patients were divided into 2 groups, optimal and suboptimal surveillance groups. Optimal patients were defined as having surveillance during the past two years that followed the guidelines, while suboptimal patients had not received surveillance that met the guidelines.

Results from the survey were presented as the number of respondents (physicians and patients) who correctly answered the surveillance knowledge questions. Percentages were used for all descriptive questions. Chi-square test was used to compare physicians' barriers between community hospitals and the higher-level hospitals, and patients' barriers between optimal and suboptimal surveillance groups. Univariate and multivariate logistic regression analyses were used to identify physicians' and patients' barriers to surveillance.

In phase 2, results were presented as the percentage of internal medicine residents who correctly answered the questions. Pre-and post-education correct answer rates were analyzed using the paired

student's t-test. A p-value of <0.05 was indicated as significant. SPSS version 23.0 was used for statistical analysis

Results

Phase 1: Barriers to HCC surveillance

A. Physician perspectives

Survey response rate among physicians was 75.6% (531/702). Mean age was 28±4 (range 22-56) years. Most respondents were GPs (n=388, 72.9%), followed by internal medicine residents (n=97, 18.3%), internists (n=44, 8.3%), and gastroenterologists (n=2, 0.4%). Most respondents worked at secondary hospitals (n=300, 56.5%), followed by community hospitals (n=134, 25.2%) and tertiary hospitals (n=97, 18.3%).

Overall, 289 (54.4%) of respondents were aware of HCC surveillance guidelines. Most physicians (n=458, 86.3%) recommended HCC surveillance of patients with cirrhosis, however, less than half of respondents recommended surveillance of high-risk chronic HBV patients (n=254, 42.4%) and HCV patients (n=225, 47.8%). Regarding surveillance tools, 228 (42.9%) respondents answered using US with or without AFP, whereas 187 (35.2%), 40 (7.5%), 48 (9.0%) and 20 (3.8%) answered US plus AFP, US alone, abdominal CT/MRI, and AFP alone, respectively. Regarding surveillance intervals, 241 (45.4%) respondents responded that the surveillance should be performed every 6 to 12 months as recommended by the national guidelines; while 202 (38.0%) and 69 (13.0%) answered the surveillance intervals of biannually and annually, and 14 (2.6%) answered that the surveillance should be done only if the patients developed symptoms. The questionnaire also posed a series of five scenarios where physicians were asked to select the correct clinical decision. The range of correct answers varied from 13.7% to 33.5%. (**Table 1**)

Table 1. Physicians' knowledge of HCC surveillance

Factors	Study phase			
	Phase 1	Phase 2*		
	(% correct)	Pre-education	Post-education	*p*
Total number of physicians	531	97	108	
Surveillance awareness	289 (54.4%)	61 (63.0%)	91 (84.3%)	<0.001
Knowledge of surveillance				
Indication for surveillance				
Cirrhosis	458 (86.3%)	90 (93.0%)	106 (98.1%)	0.088
CHB with indications	254 (47.8%)	39 (40.0%)	68 (63.0%)	0.001
CHC with indications	225 (42.4%)	53 (55.0%)	69 (63.9%)	0.178
Surveillance tools(s)	228 (42.9%)	41 (42.0%)	64 (59.3%)	0.092
Surveillance interval(s)	241 (45.4%)	43 (44.0%)	55 (50.9%)	0.604
Scenarios-based questions	-	-	-	-
Compensated cirrhosis	153 (28.8%)	36 (37.0%)	69 (63.9%)	0.002
Decompensated cirrhosis	178 (33.5%)	37 (38.0%)	59 (54.6%)	0.056
History of HCC in first degree relative(s) in CHB non-cirrhosis	162 (30.5%)	28 (29.0%)	62 (57.4%)	0.004
Male with CHB non-cirrhosis, age > 40 years	173 (32.6%)	34 (35.0%)	65 (60.2%)	0.007
Female with CHB non-cirrhosis, age >50 years	73 (13.7%)	21 (22.0%)	43 (39.8%)	0.014

*number (%) presents the number of internal medicine residents who correctly answered the questions.

Regarding physicians' attitudes, most believed that HCC surveillance was cost-effective (n=472, 88.9%) and did not increase their workloads (n=513, 96.6%). A little over half (n=288, 54.2%) thought that surveillance was the responsibility of all physicians (n=288, 54.2%) who worked with at-risk HCC patients. When asked about patients with a history of heavy alcohol, 157 (29.5%) physicians admitted that it might

influence them with 31 (5.8%) responding with a strong negative impact and 126 (23.7%) with a moderate negative impact to perform fewer HCC surveillance tests. **(Supplemental Table 1)**

Regarding the barriers for surveillance, only 32 (6.0%) to 43 (8.0%) physicians reported concerns about the costs of surveillance tools. Instead, many physicians reported the lack of access to an adequate US machine (n=342, 64.4%) and AFP test (n=291, 54.8%) as a major barrier. This concern was more common at the primary care hospitals compared to secondary or tertiary care hospitals **(Table 2)**.

Table 2. Physicians' barriers related to HCC surveillance tools

Barriers to HCC surveillance	Overall (n=531)	Community hospitals (n=134)	Secondary and tertiary centers (n=397)	*p*
Factors related to US machine				
No limitation	189 (35.6%)	39 (29.1%)	150 (50.0%)	<0.001
Unavailable US machine	85 (16.0%)	75 (56.0%)	10 (3.3%)	<0.001
Limited access to US machine	154 (29.0%)	24 (17.9%)	130 (43.3%)	<0.001
Financial limitation	33 (6.2%)	13 (9.7%)	20 (6.7%)	0.272
Factors related to AFP measurement				
No limitation	240 (45.2%)	26 (19.4%)	214 (71.3%)	<0.001
Unavailable AFP test	128 (24.1%)	97 (72.4%)	31 (10.3%)	<0.001
Financial limitation	89 (16.8%)	28 (20.9%)	61 (20.3%)	0.878

B. Patient perspectives

Completion rate for the patient questionnaire was 79.3% (303 out of 382). It should be highlighted that only 92 (30.3%) patients were undergoing optimal HCC surveillance, and 211 (69.6%) patients had suboptimal surveillance. Baseline characteristics including age, gender, educational level, income, HCC risk, medical specialty of health care providers and knowledge about HCC showed no significant differences between the 2 groups (**Table 3**). Barriers for not receiving HCC surveillance include a lack of surveillance prescription from physicians, long appointment intervals, failure to recall the appointment, long distances from home to a hospital, inequality of health insurance status, transportation difficulty, and the cost of surveillance test. **(Supplemental Table 2)** In comparison between those receiving optimal and suboptimal surveillance, the reported lack of a US prescription from a healthcare provider was the only factor showing a significant association with suboptimal surveillance (OR (95%)=1.4(1.1-1.8), p=0.024) (**Table 4**).

Table 3. Baseline characteristics of high-risk HCC patients

Factors	Optimal surveillance (n=92, 30.3%)	Suboptimal surveillance (n=211, 69.6%)	p-value
Age, mean±SD (years)	57.4±9.8	55.4±11.9	0.170
Male gender	50 (54.9%)	41 (45.1%)	0.374
Education level			0.514
- Low (primary school or under)	48 (52.2%)	99 (46.9%)	
- Medium to high (secondary school or higher)	44 (47.8%)	112 (53.1%)	
Income (low vs. medium to high)			0.363
- Low (≤ 330 US dollars per month)	18 (19.6%)	51 (24.2%)	
- Medium to high (> 330 US dollars per month)	74 (80.4%)	160 (75.8%)	
Types of medical coverage and insurance			0.122
- Universal coverage	25 (27.2%)	63 (29.9%)	
- Government/state enterprise officer	39 (42.4%)	74 (35.1%)	
- Social security	11 (12.0%)	35 (16.6%)	
- Others	17 (18.5%)	39 (18.5%)	
Surveillance indications			
- Cirrhosis	75 (81.5%)	182 (86.3%)	0.428
- High-risk non-cirrhosis	17 (18.5%)	29 (13.7%)	0.387
Healthcare providers			
gastroenterologist vs.	53 (62.4%)	112 (59.6%)	0.284
non-gastroenterologist			
Mean knowledge score (%)			
Total score	41.9±13.7	41.2±14.8	0.680
Risk of HCC	53.9±24.1	53.0±24.5	0.773
Prognosis of HCC	48.9±26.3	48.2±30.5	0.854
Optimal tool and interval for surveillance	37.3±14.7	36.2±15.1	0.614

Table 4. Factors associated with suboptimal surveillance by patient's perspective

Factors	OR (95% CI)	p
Patient demographics		
Female gender	0.8 (0.5-1.3)	0.354
Older age	0.8 (1.0-1.0)	0.170
Low education level (vs. medium to high)	0.8 (0.5-1.4)	0.451
Low monthly income (vs. medium to high)	1.4 (0.7-2.5)	0.328
Types of medical coverage and insurance	1.1 (0.9-1.3)	0.335
Patient knowledge		
Risk of HCC	1.0 (0.99-1.01)	0.772
Natural history and burden of HCC	1.0 (0.99-1.01)	0.853
HCC surveillance guidelines	1.0 (0.98-1.01)	0.613
Attitude to HCC surveillance		
Knowing HCC surveillance guidelines is importance for early HCC detection	0.8 (0.3-1.9)	0.585
Responders had high risk of developing HCC	0.9 (0.6-1.4)	0.714
Responders were at risk of death from HCC	1.0 (0.7-1.5)	0.829
US and AFP are beneficial tools for detecting early HCC	0.6 (0.3-1.2)	0.151
Responders received sufficient advise and knowledge about HCC surveillance from physicians	1.1 (0.7-1.6)	0.750
Major surveillance barriers		
Lack of surveillance prescription from physicians	1.4 (1.1-1.8)	0.024
Non-gastroenterologist was a care provider	1.0 (0.9-1.1)	0.465
Surveillance indication (cirrhosis vs. non-cirrhosis)	1.0 (1.0-1.0)	0.263

Patient lives too far from hospital	1.0 (0.8-1.4)	0.839
Forget surveillance schedule	1.1 (0.8-1.6)	0.466
Long waiting time for doctor visit and surveillance	0.9 (0.7-1.2)	0.426
No caregiver to assist with visiting hospital	0.9 (0.6-1.3)	0.567
Financial concern	1.1 (0.8-1.5)	0.706
Healthcare re-imbursement and referral system	1.1 (0.8-1.6)	0.650

Phase 2: Improving physicians' knowledge on HCC surveillance with brief educational intervention

Of the 143 internal medicine residents, response rates before and after delivery of the brief educational intervention were 67.8% (n=97) and 75.5% (n=108), respectively. Baseline characteristics are shown in **Supplemental Table 3**. Baseline data **(Table 1)** show that 61 (63.0%) residents self-reported awareness of the HCC surveillance guidelines, with 90 (93.0%) remembering cirrhosis as a surveillance indication, and 40.0%-55.0% of residents correctly identified indications for non-cirrhosis patients. Only 42.0% and 44.0% of residents correctly chose the surveillance tools and intervals, respectively. Data from the 5 problem-based scenarios showed correct answer rates ranging from 22.0%-38.0%.

After delivering the brief educational intervention via social network messaging, we confirmed that all participants have read the card. Correct answer rates increased in all domains, particularly indications for HCC surveillance in chronic HBV non-cirrhosis patients (40.0% vs. 63.0% at pre- and post-education, respectively, p=0.001). The percentage of correct decisions of all but one case surveillance scenario significantly increased after education (**Table 1**). No other knowledge area statistically improved between pre and post-education. After the educational intervention, most residents (n=85, 78.7%) strongly disagreed that HCC surveillance increased their workload (**Supplemental Table 4**).

Discussion

Our study surveyed physicians' knowledge, attitudes and practices regarding HCC surveillance among at-risk patients. The low level of physicians' knowledge was found to be the most important barrier for HCC surveillance. Survey results from high-risk patients revealed that the lack of a physician's prescription for ultrasound was identified as a central barrier for HCC surveillance. Educating physicians through the distribution of brief knowledge cards via social network platforms was a simple, convenient and an effective strategy to enhance physicians' knowledge.

Previous findings on barriers to HCC surveillance have found great variation between region around the world based on many factors including personal belief, cultures, environment, financial issue and supporting healthcare systems, which showed large differences between developing and developed countries.[9-11] Surveillance barriers among developing countries featuring an Asian socioeconomic environment have not been widely studied. The majority of participating physicians in our study were GPs and internists (81.2%), who provide care to most patients with cirrhosis and chronic HBV/HCV infection, working at primary and secondary hospitals (81.7%), which serve the majority of the population,[12, 13] they play a critical role in implementing the national HCC guidelines. Our information can provide important evidence for policy-makers who set national healthcare budgets and surveillance program. Moreover, results from our survey should generalize to other countries with resource-based limitations that cause a lack of adequate equipment.

Previous research has identified a number of barriers to HCC surveillance including socioeconomic factors, HCC knowledge and awareness, attitudes for surveillance, financial concerns and healthcare systems.[9, 11, 14, 15] All of these were mentioned as important issues in our study. Notably, the lack of a surveillance prescription from their doctor was the only barrier demonstrating significant difference between patients undergoing optimal and suboptimal surveillance.

Few studies have addressed physicians' attitudes toward HCC surveillance[10, 15, 16]. Most physicians in our study were aware of HCC surveillance recommendations and held positive attitudes towards them. They believed that HCC surveillance is a responsibility shared by all healthcare providers regardless of medical specialty and hospital limitations. They responded overwhelmingly that it is cost effective and does not significantly increase their workload. The positive attitudes found in Thai physicians and similar to studies from the United States[10, 15, 16]. Physicians were asking about whether they would recommend surveillance to patients with alcoholic cirrhosis who was active drinkers. One-third of physicians responded that it may influence their decision to offer HCC surveillance if they knew the cirrhosis patient was not yet sober. The study did not measure whether this attitude impacted real-life decisions by these physicians. It is unclear whether it really had a negative impact on their real-life practice.

Resource availability was seen as a barrier to HCC surveillance among physicians. Approximately 45% of physicians reported having limited access to US machines, particularly in primary care settings and hospitals located in highly populated areas. These locations typically prioritize use of US machines as a diagnostic tool in symptomatic patients, rather than a screening and surveillance tool in asymptomatic patients. These findings illustrate that even with knowledge of the guidelines and a pro-active attitude for surveillance among GPs, it might be difficult to get access to US equipment for this prevention purpose. These situations have been documented as barriers in many other countries with limited resources[17]. Machine capacity was also identified as potential barrier even in high-income countries, such as the United States, but it was not perceived as a major concern[10]. An international survey conducted in low to middle-income countries showed that apart from the lack of equipment and maintenance capability, the lack of training (60%) was also a key barrier for the use of US screening for HCC in resource-limited

settings[18]. In addition to US access barriers, our study found that the AFP test was unavailable AFP test at 72.4% of primary hospitals. This might be due to the greater versatility of the US machine compared to the AFP test.

Research has found significant socioeconomic differences in surveillance adherence. Low socioeconomic status was found to be a significant predictor of non-adherence to surveillance in the United States[19]. A study from Switzerland showed that patients with private health insurance, typically received by persons with higher incomes, more frequently underwent HCC surveillance[14]. Financial constraints and the type of health insurance system have been found to be significant barriers for surveillance in high income countries[10, 11, 15]. In contrast, upper-middle income countries such as China[9] and Thailand with national health systems showed only a minor negative impact from the socioeconomic status of patients and access to surveillance. Studies have also found that even when patients and physicians expressed a concern about the cost of surveillance, it was not found to be a significant barrier in comparison to inadequate knowledge[20, 21]. In Thailand, the universal medical coverage scheme supports HCC surveillance program for all high-risk patients, which relieves most of the patients' financial concerns. This has also been observed in the United States among patients with stable health insurance enrollment who have reported less financial concern[22]. This underscores the critical role that health coverage can play in increasing the rate of HCC surveillance.

Although physicians in our study were motivated to prescribe surveillance without any resource and financial concerns, the rate of performing surveillance remained low, even at the academic center location which reported a suboptimal surveillance rate of 69.6%. A large systematic review has shown that physician barriers to guideline adherence include awareness, familiarity, agreement, self-efficacy, outcome expectancy and patterns of previous practice[23]. The lack of knowledge by healthcare providers was the most important barriers for appropriate HCC surveillance identified in our study. This finding was consistent with most studies from the United States[24-27]. It should be noted that 54.4% of physicians in our study were aware of the guidelines and no differences were found in receipt of surveillance between gastroenterologists and GPs. Only half (54.4%) of physicians correctly answered the guideline recommendations, and one-third or fewer (28.8-33.5%) selected the correct answers in the case-based scenario questions. These findings show that "recall and understand" is the key problem, not just ensuring that physicians are "aware" of the guidelines. A survey in the United States showed that the lack of guideline comprehension contributed to a negative attitude among 56% of GPs toward recommending surveillance as they felt discomfort and had a lack confidence to communicate with patients[15]. Accordingly, measures to improve the comprehension of the guidelines should be prioritized, instead of just simple dissemination particularly to GPs who typically serve this population.

Findings from the second phase of this study support the linkage between increasing knowledge and attitudes and increasing HCC surveillance. We created and disseminated an educational card with brief, simple, easy-to-remember HCC surveillance information. The use of social media was the highest among young physicians, especially at the age of residency training, and was shown to improve clinical

education.[28] The card was distributed through the Facebook platform and LINE app, which is one of the most popular communication applications in Thailand. The card aimed to remind and educate about HCC surveillance recommendations to internal medicine residents. The residents were able to download the educational card and keep it in their personal mobile phones. Comparing pre- and post-education knowledge levels, scores increased in all aspects, particularly in the area of knowing indications for initiating surveillance, while giving education did not result in negative impact to surveillance attitudes. It should be noted that even though the scores for surveillance tools, intervals, and case scenarios increased after the educational intervention, a large percentage of physicians still did not answer surveillance questions correctly. Nonetheless, our results demonstrated that educating physician using our brief social network-based intervention was effective and could be an attractive strategy to boost overall HCC surveillance rate.

It is well recognized that the presence of cirrhosis, chronic HBV and HCV infection increases the risk of HCC development, however a vast majority of physicians correctly answered (86.3%) the presence of cirrhosis as surveillance indication only, while 42.4% and47.8% of physicians correctly answered chronic HBV and HCV infection as surveillance indications, respectively. For the rest of the knowledge questions, the rate of correct answers for questions on surveillance indication among non-cirrhosis, tools and intervals were all less than 50%. Notably, 85.6% of responders answered using US as the screening tool, but 42.7% of respondents were uncertain about the role of AFP in combination with US. Moreover, 83.4% of physicians suggested surveillance at least every 6 months. These responses imply that most physicians know the concept of surveillance, but the exact guidelines recommendations are too complex to remember. This is supported by results of case-scenarios questions showing that the more complicated the hypothetical situation of the patient, the lower the rate of selecting the optimal answer. Educating physicians on how to recognize surveillance and remembering recommendations are crucial to efficiently promoting surveillance since it is economical, time-saving, and easy to implement.

Strengths of our study include the wide range of physician participants both in type and specialties and the wide geographical ranges of sites (tertiary, secondary, community, academic). We assessed both physicians' and patients' perspectives. Most previous studies were performed in the Western countries with high income[4, 10, 11, 14-16, 22, 23, 25, 27, 29, 30]our study took place in Thailand, a middle income, developing country. We believe our findings might be generalizable to other Asian/Eastern countries with a similar development and income status, especially one that provides national health coverage. There are several limitations to our study. Survey studies are inherently plagued by response bias. Questionnaires were based on findings from previous studies, which used close-ended questions instead of some open-ended questions, which might have caused some barriers to be missed. Physicians in our study may have answered questions regarding how they should practice, instead of how they actually practice. Regarding the brief education intervention, we allowed residents to download and keep the card in their device. We did not check the frequency of the cards being read or request participants to review the card before performing the post-test. In the future, we plan to assess improvement of HCC

surveillance and early HCC detection rate in real-life practice after implementing additional physician education on HCC surveillance.

Conclusions

Gaps in knowledge among healthcare providers was found as a major barrier for HCC surveillance based on physicians' and patients' perspectives. This appears to translate into not always providing at-risk patients with an US prescription. Dissemination of a brief knowledge card on HCC surveillance via instant messaging apps showed promise as an easy and effective education tool to improve physician understanding and recognition of surveillance recommendations.

List Of Abbreviations

HCC: hepatocellular carcinoma

US: ultrasound

AFP: alpha-fetoprotein

THASL: Thai Association for the Study of the Liver

HBV: hepatitis B virus

HCV: hepatitis C virus

GP: general practitioner

Declarations

Ethics approval and consent to participate: The study was approved by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University (IRB number 618/58). Informed consent was obtained from all study participants.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: All authors declare that they have no potential conflicts (financial, professional, or personal) of interest.

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Authors' contributions: TT performed statistical analysis and data interpretation, and drafted the manuscript; YS designed instruments and collected data in phase 1 of the study; PP and PP designed instruments and collected data in phase 2 of the study; CP assisted with statistical analysis; PT, ST and RR provided oversight for the study, performed critical revisions of the important intellectual content, and obtained study funding; RC designed and supervised the study, performed data interpretation and critical revisions of the important intellectual content. All authors have read and approved the final manuscript.

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Figures

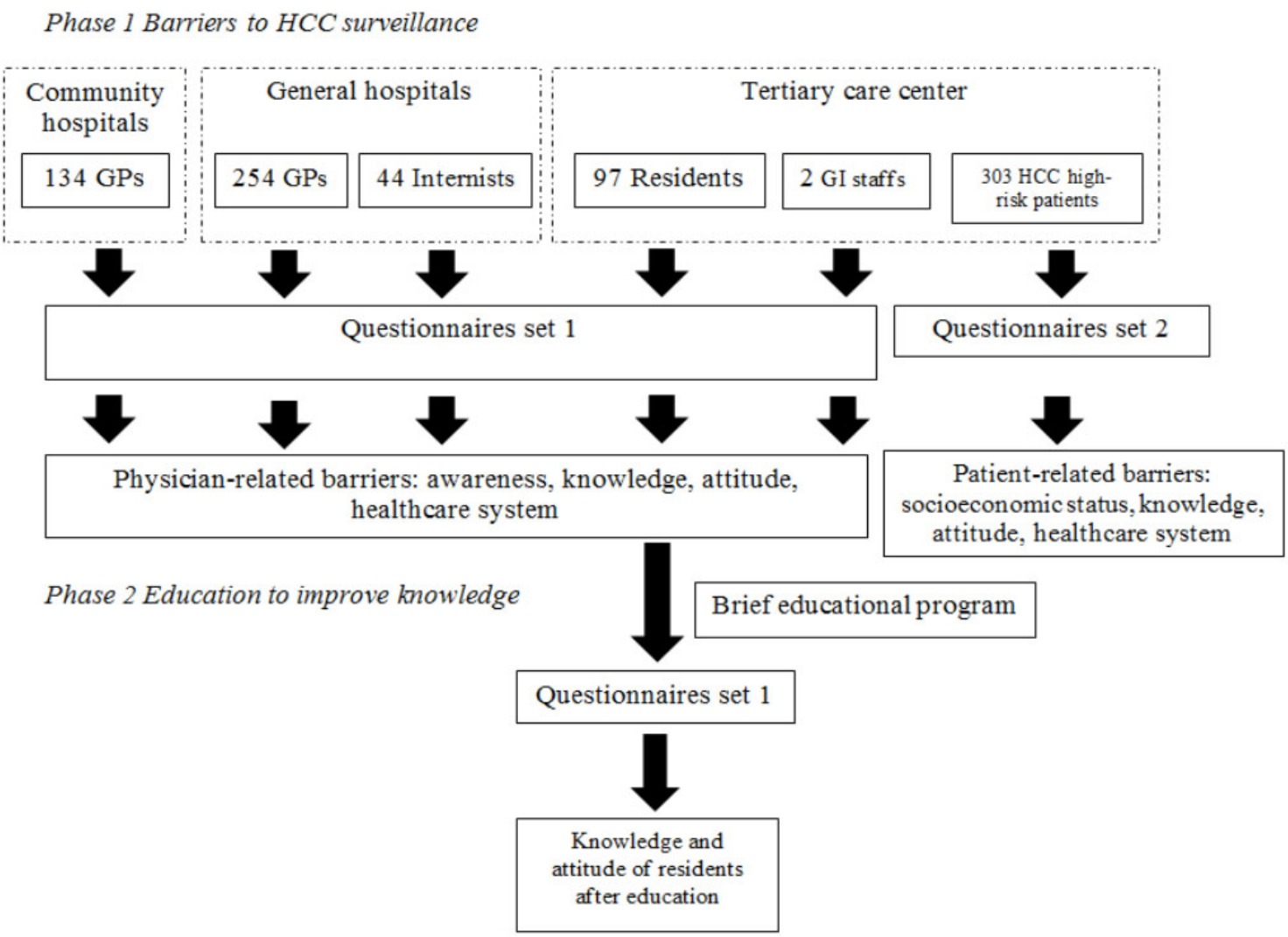

Figure 1

Study flow

HCC surveillance guidelines

We recommended performing surveillance in patients with one of the following conditions:
1. Cirrhosis from any cause
2. Chronic HBV infection in male with age ≥ 40 years and female with age ≥ 50 year
3. Chronic HBV infection and has history of HCC in the first degree relative
4. Chronic HCV infection with ≥ F3 degree of fibrosis detected by liver histology, regardless of previous treatment

Methods and interval of HCC surveillance

We recommended performing upper abdominal ultrasonography as the main surveillance tool every 6-12 months or in combination with serum alpha-fetoprotein test (Evidence grade D, level of recommendation grade 1B)

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Figure 2

Knowledge card

Supplementary Files

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