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Referring clinicians' knowledge, attitudes and practice towards international guidelines for liver cancer diagnosis in Singapore

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INTRODUCTION

Hepatocellular carcinoma (HCC) is the seventh most common malignancy and the fourth leading cause of death worldwide.⁽¹⁾ HCC is the only malignancy that can be diagnosed and treated without the need for histological confirmation. However, the imaging diagnosis of HCC can be established only in patients who have risk factors for HCC, and in the presence of characteristic imaging features.^(2,3) Given the heterogeneity of HCC phenotypes and the need for definitive diagnosis by imaging to guide treatment, classifying liver observations in a standardised and commonly understood manner in patients at risk of HCC is of paramount importance. This facilitates early detection and appropriate treatment, and has shown to improve survival.^(4,5)

Several workgroups have developed imaging criteria for the diagnosis of HCC. Mooted in 2011 by the American College of Radiologists (ACR), the LI-RADS is a dynamic document that has undergone four updates in the span of seven years,⁽⁶⁾ the most recent update culminating with the LI-RADS gaining adoption by referring clinicians into the American Association for the Study of Liver Diseases (AASLD) guidelines in 2018.⁽⁷⁾

HCC development is postulated to be a stepwise process, with progressive hepatocarcinogenesis of cirrhotic nodules into HCC. The criteria in LI-RADS classifies the observations of liver nodules in at-risk patients into discrete categories based on major and ancillary imaging features.⁽⁸⁾ Based on the classification, recommendations will be proposed accordingly, from observation in the definitely and most probably benign (LR-1 and LR-2) lesions, to biopsy or treatment in the most probably and definitely HCC (LR-4 and LR-5) lesions.⁽⁹⁾ The likelihood of HCC in each category has recently been described in a systematic review.⁽¹⁰⁾ This is different from other international criteria, where the algorithm is dichotomised into HCC versus non-HCC, with less guidance on management of nodules in between – a relatively common occurrence.

In Singapore, HCC is the fourth most common malignancy among men, with an age-standardised incidence of 17.7%.⁽¹⁾ Given the higher prevalence and disease burden posed by HCC in Singapore compared to the rest of the world,⁽¹⁾ it is timely to review the adoption of contemporary guidelines in Singapore.

In this study, we designed and conducted a survey to identify current practices for reporting of liver observations on computed tomography (CT) and magnetic resonance (MR) imaging in patients at risk of HCC in Singapore, with a focus on clinician knowledge of and attitudes towards LI-RADS. In addition, we would identify perceived barriers against the implementation of LI-RADS and recommend key steps that can be taken towards addressing those barriers.

METHODS

Institutional Review Board approval was obtained prior to conducting the survey. The survey questions were developed by two abdominal radiologists in our institution with 15 and seven years of experience. The questions were vetted with the aid of a medical writer and senior epidemiologist to ensure that they were interpreted to be neutral and did not contain leading questions. The questions were further refined to ascertain that they were easy to understand and allowed the research team to collect information required to make meaningful conclusions.

The final survey consisted of 18 questions structured in a multiple-choice format (Appendix). A short introductory paragraph was included to explain the rationale and goals of the survey.

The questions were compiled onto a free online platform (Google Forms, Google LLC). The survey link was distributed to clinicians involved in the care of patients diagnosed with or at risk of developing HCC. These included hepatobiliary and general surgeons, interventional radiologists, medical oncologists and gastroenterologists.

Some questions allowed for only one answer while others allowed for multiple options to be selected. Free text options were also available for some questions. Respondents were anonymous so as to allow for them to freely express their opinions and encourage honest feedback.

Upon completion, the survey was shared via email and messaging platforms. The heads of various professional associations within Singapore (Gastroenterology Society of Singapore, Singapore Society of Oncology and the Singapore chapter of the Asian-Pacific Hepato-Pancreato-Biliary Association) were contacted via email and the survey was forwarded to its members by the association secretariats. The survey was kept open for four weeks from 23 October to 23 November 2020.

Anonymised responses were recorded by frequency and percentage on Google forms. This was imported onto an Excel spreadsheet for further analysis. Subgroup analysis of the perceived difference in probabilities of HCC, in an observation classified as LR-3 versus LR-4, between surgeons (hepatobiliary and general) and physicians (gastroenterology and medical oncology) was performed.

RESULTS

Table I describes the demographics of our respondents. The sample population within this study was fairly uniform across junior and senior clinicians and also across the different subspecialties.

Table I. Participant characteristics.

Characteristic	No. (%)
Appointment	
Senior resident/associate consultant	19 (40.4)
Consultant	12 (25.5)
Senior consultant	16 (34.0)
Years of practice	
0–5	28 (59.6)

6–10	5 (10.6)
11–15	11 (23.4)
≥ 16	3 (6.4)
Speciality	
Interventional radiology	13 (27.7)
Hepatobiliary/general surgery	16 (34.0)
Gastroenterology	10 (22.7)
Medical oncology	8 (17.0)
Location of practice	
Government/university hospital	44 (93.6)
Private practice	3 (6.4)
Attendance of multi-disciplinary meeting for liver tumours	
Once a month	9 (19.1)
Twice a month	7 (14.9)
Three or more times a month	31 (66.0)

Table II summarises the knowledge and attitudes towards reporting guidelines. A total of 45 (95.7%) participants were aware of the existence of LI-RADS, while 35 (74.5%) were aware of AASLD prior to its merging with LI-RADS in 2018, and 30 (63.8%) were aware of EASL. APASL and OPTN were less well known, with only 17 (36.2%) and 3 (6.4%) participants, respectively, being aware of them.

LI-RADS was the most frequently used guideline (27/47, 57.4%). Otherwise, participants were either unsure of the use of any guideline (7/47, 14.9%) or practised in institutions where no guideline was being used (5/47, 10.6%). A fraction of participants also used the AASLD guidelines prior to its incorporation with LI-RADS (5/47, 10.6%). LI-RADS was the most preferred guideline for characterisation of liver lesions (26/47, 55.3%). The next most common response was that of no guideline preference (16/47, 34.0%). 7 (14.9%) participants were very familiar with LI-RADS, while 39 (83.0%) were somewhat familiar with LI-RADS (i.e. aware of broad categories of LI-RADS 1–5 but not the inclusion criteria). However, only 28 (60.9%) participants knew of the existence of a separate LI-RADS algorithm for lesions that underwent locoregional therapy.

Table II. Knowledge and preference of reporting guidelines (Questions 6–10).

Parameter	No. (%)
Awareness of following HCC reporting guidelines*	
LI-RADS	45 (95.7)
APASL	17 (36.2)
EASL	30 (63.8)
AASLD (prior to merging with LI-RADS)	35 (74.5)
OPTN	3 (6.4)
Reporting guideline used in current institution	
LI-RADS	27 (57.4)
APASL	1 (2.1)
EASL	1 (2.1)
AASLD (prior to merging with LI-RADS 2018)	5 (10.6)
OPTN	0 (0)
None	5 (10.6)
Not sure	7 (14.9)
Mix of guidelines	1 (2.1)
Preferred guideline for characterisation of liver lesions	
LI-RADS	26 (55.3)
APASL	0 (0)
EASL	2 (4.3)
AASLD (prior to merging with LI-RADS 2018)	3 (6.4)
OPTN	0 (0)
No guideline preference	16 (34.0)
Familiarity with LI-RADS	
Very familiar (aware of major diagnostic criteria required for each LI-RADS score as well as implications of LI-RADS score)	7 (14.9)
Somewhat familiar (aware of broad categories of LI-RADS 1–5 but not the inclusion criteria)	39 (83.0)
I do not know how LI-RADS is structured	1 (2.1)
Knowledge of separate LI-RADS algorithm for lesions that have undergone loco regional therapy (46 responses)	
I am aware and know that it is classified according to whether the lesion is viable or not	12 (26.1)
I am aware of its existence but do not know how it is used	16 (34.8)
I do not know that there is a separate algorithm	18 (39.1)

*Participants were asked to check all applicable options. HCC: hepatocellular carcinoma

Table III summarises the participants' opinion on the implications of the LI-RADS score. 19 (40.4%) participants reported having more than 75% of CT/MR imaging studies performed for patients at risk of HCC using LI-RADS as the reporting guideline.

Most (51.1%) participants believed that the probability of HCC in a LR-3 lesion was low (25%–50%), compared to LR-4 lesions, which the majority (45.7%) felt had a moderate likelihood (50%–75%) of being malignant.

Subgroup analysis of the LI-RADS score assessment was also performed between the surgeons and internists. Most (62.5%) surgeons believed that the probability of HCC in a LR-3 lesion was low (25%–50%) while most (55.6%) internists believed that the probability of HCC in a LR-3 lesion was moderate (50%–75%). Most (50%) surgeons also believed that the probability of HCC in a LR-4 lesion was moderate (50%–75%) while most (55.6%) internists believed that the probability of HCC in a LR-4 lesion was high (75%–100%). Most (30/47, 63.8%) participants wanted the LI-RADS score to be mentioned in radiology reports for CT/MR imaging and would follow the recommendation for subsequent management based on the LI-RADS score (45/46, 97.8%).

Table III. Opinion on implications of LI-RADS score (Questions 11–14, 17).

Opinion	No. (%)
Percentage of CT/MR imaging studies performed for patients at risk of HCC whereby LI-RADS is used	
None	8 (17.0)
1–25	8 (17.0)
25–50	9 (19.1)
50–75	3 (6.4)
>75	19 (40.4)
What do you think is the probability of HCC in an observation classified as LR-3?	
Very low likelihood/not at all (0%–25%)	6 (12.8)
Low likelihood (25%–50%)	24 (51.1)
Moderate likelihood (50%–75%)	16 (34.0)
High likelihood (< 75%)	1 (2.1)
What do you think is the probability of HCC in an observation classified as LR-4? (46 responses)	
Very low likelihood/not at all (0%–25%)	1 (2.2)
Low likelihood (25%–50%)	6 (37.5)
Moderate likelihood (50%–75%)	21 (45.7)
High likelihood (> 75%)	18 (39.1)
Probability of HCC in LR-3 lesion in surgeons compared to internists	
Very low likelihood/not at all (0%–25%)	4 surgeons, 0 internists

Low likelihood (25%–50%) Moderate likelihood (50%–75%) High likelihood (> 75%)	10 surgeons, 8 internists 2 surgeons, 10 internists 0 surgeons, 0 internists
Probability of HCC in LR-4 lesion in surgeons compared to internists Very low likelihood/not at all (0%–25%) Low likelihood (25%–50%) Moderate likelihood (50%–75%) High likelihood (> 75%)	0 surgeons, 0 internists 4 surgeons, 1 internist 8 surgeons, 7 internists 4 surgeons, 10 internists
Preference for radiology reports for multiphasic CT/MR imaging for HCC to include the LI-RADS score? Yes, I want the LI-RADS score to be mentioned I am neutral, I do not mind the LI-RADS score being mentioned but I do not need it either I do not want the LI-RADS score to be mentioned	30 (63.8) 17 (36.2) 0
Would you adopt the radiology report recommendation for subsequent management based on the LI-RADS score? (46 responses) I would follow the recommendation for subsequent management and/or surveillance I would not follow both management and surveillance recommendations	45 (97.8) 1 (2.2)

HCC: hepatocellular carcinoma

Tables IV and V summarise the perceived effectiveness of LI-RADS. Most (> 80%) participants agreed that LI-RADS was very effective or effective in conveying the malignant potential of the observed lesion, while there was less robust agreement regarding the effectiveness of LI-RADS in conveying the presence of malignant neoplasm invading the adjacent vasculature (Table IV).

There was also agreement (> 80%) that LI-RADS was effective, if not very effective, in its role in facilitating multidisciplinary meetings and treatment-making decision, interdisciplinary communication and explaining results to patients. Only 4 (8.7%) participants felt that LI-RADS was not effective in communicating results to patients (Table V).

Table IV. Effectiveness of LI-RADS in communicating the following information (46 responses, Question 15).

Perceived effectiveness	Score			
	1	2	3	4
Whether an observation is definitely HCC	1 (2.2%)	7 (15.2%)	22 (47.8%)	16 (34.5%)
Whether an observation is probably HCC	0 (0%)	9 (19.6%)	33 (71.7%)	4 (8.7%)
Whether an observation has an intermediate probability of malignancy	1 (2.2%)	18 (39.1%)	23 (50.0%)	3 (6.5%)
Whether an observation being probably or definitely malignant, but not specific for malignancy	4 (8.7%)	16 (34.5%)	25 (54.3%)	1 (2.2%)
Presence of a malignant neoplasm invading adjacent vasculature	7 (15.2%)	13 (28.3%)	21 (45.7%)	5 (10.9%)

1 – not effective, 2 – somewhat effective, 3 – effective, 4 – very effective. HCC: hepatocellular carcinoma

Table V. Effectiveness of LI-RADS in the following scenarios (46 responses, Question 16).

Perceived effectiveness	Score			
	1	2	3	4
Facilitation of MDT discussion	0 (0%)	3 (6.5%)	33 (71.7%)	10 (21.7%)
Facilitation in treatment making decisions	1 (2.2%)	7 (15.2%)	29 (63.0%)	9 (19.6%)
Communication of results with patients	4 (8.7%)	15 (32.6%)	23 (50.0%)	4 (8.7%)
Communication with other specialities	1 (2.2%)	8 (17.4%)	33 (71.7%)	4 (8.7%)
Communication with difference hospitals	0 (0%)	8 (17.4%)	33 (71.7%)	5 (10.9%)

1 – not effective, 2 – somewhat effective, 3 – effective, 4 – very effective. MDT: multidisciplinary team

Table VI summarises the barriers against LI-RADS implantation. The most common perceived barriers to implementing LI-RADS were non-utilisation of LI-RADS by other clinical specialities involved in patient care (55.6%) and radiologists' lack of familiarity with LI-RADS (55.6%). Personal lack of familiarity with LI-RADS (48.9%) and interobserver variability in lesion characterisation (46.7%) were some of the other more common responses.

Table VI. Barriers in implementing LI-RADS (45 responses).

Perceived difficulties in implementing LI-RADS at current institution*	No. (%)
Radiologists not familiar with using LI-RADS	1 (2.2)
Personal lack of familiarity with LI-RADS	22 (48.9)
Other specialities involved with the care of patients not using LI-RADS (hepatology, oncology, hepatobiliary surgery)	25 (55.6)
Preference for other guidelines	7 (15.6)
LI-RADS terminology is too complex and restrictive	7 (15.6)
Interobserver variability in lesion characterisation	21 (46.7)
Management guidelines proposed by LI-RADS do not complement my institutional practices	3 (6.7)
LI-RADS is not sensitive enough in our local context	1 (2.2)
Other: The repeat 3-6 months can be quite vague	1 (2.2)

*Participants were asked to check all applicable options.

DISCUSSION

The objective of this survey was to understand our colleagues' knowledge, attitudes and practices with regards to HCC imaging guidelines, and identify barriers towards implementing LI-RADS. This would promote better standard of care practice in the diagnosis and management of HCC.

Although many (95.7%) participants were familiar with LI-RADS, only slightly more than half (57.4%) were using LI-RADS in their current place of practice. Furthermore, the utilisation rate was inconsistent, ranging from less than 25% to more than 75%. Of the 20 (42.6%) respondents who were not using LI-RADS, nine had no preference on guideline usage for characterisation of liver lesions. Therefore, one can infer that clinicians would prefer to leave the choice of guideline to their institution's radiologists, demonstrating more impetus for local radiologists to arrive at a consensus on whether LI-RADS should be the guideline to adopt. A number of clinicians reported not knowing which guidelines their institution was using (7/47), with some also indicating that they are currently not using any guideline (5/47) for the diagnosis and management of HCC. When combined, these made up 25.5% of respondents. This was not confined to junior staff, as three respondents were senior consultants and three were consultants

(50%). This suggests that some institutions would benefit from formally establishing the use of LI-RADS in clinical practice and multidisciplinary meetings.

Based on our survey, despite only 14.9% of participants being very familiar with LI-RADS and its inconsistent utilisation rate, the majority (63.8%) still expressed a preference to adopt LI-RADS and include the LI-RADS score in the radiology report, suggesting that radiologists' adoption of LI-RADS in Singapore could be improved. Furthermore, the majority also felt that LI-RADS is effective in interdisciplinary communication and facilitating treatment-making decisions. Therefore, the use of LI-RADS should be promoted in Singapore.

LI-RADS classifies observations not 'definite' for HCC into LR-3 and LR-4 categories based on their major and ancillary imaging.⁽⁸⁾ The classification system takes into account ancillary features only available on MR imaging such as T2 signal intensity, diffusion restriction, intralesional fat and hepatobiliary phase defect. Some of these features have not been incorporated in other guidelines such as the European Association for the Study of the Liver (EASL) guidelines of the management of HCC⁽¹²⁾ and the APASL guidelines. Given the fairly widespread use of MR imaging in Singapore for evaluation of liver lesions in the at-risk group and the need for more standardised approach towards dealing with the non-'definite' lesions for early diagnosis and treatment, LI-RADS would be more relevant in the local context. The latest version of the KLCA-NCC Korea Practice Guideline for the Management of HCC⁽¹³⁾ also integrates MR imaging findings into the diagnostic algorithm and has features very similar to the 2018 version of LI-RADS. However, the KLCA-NCC diagnostic criteria uses a broader definition of washout appearance (to include hypointensity on the transitional and hepatobiliary phases), which results in increased sensitivity for detection of HCC; however, this is not universally accepted.

There was a higher threshold for the probability of HCC in LR-3 and LR-4 lesions amongst the surgeons compared to the internists. A recent systematic review showed that the

percentage of HCC in LR-3 observations is moderate at approximately 38%⁽¹⁰⁾, whereas the percentage of HCC in LR-4 observations is high at 80%.⁽¹⁰⁾ Interestingly, most surgeons surveyed believed that the likelihood of HCC in LR-3 and LR-4 lesions was ‘very low’ (25%), or ‘low’ (62.5%), which diverges from published data. On the other hand, among the internists, the majority (55.6%) believed that LR-3 lesions had a ‘moderate’ likelihood of being HCC, and that LR-4 lesions had a ‘high’ likelihood of being HCC (55.6%). The differences between the two groups could be attributable to the fact that liver resection would entail a certain amount of morbidity and mortality. As such, surgeons may tend to regard imaging findings as clinically significant only when the observation shows definite features of HCC or malignancy (LR-5), and less so for the lower-risk lesions (LR-4 and LR-3). Nevertheless, almost all participants (97.8%) still expressed that they would follow management recommendations.

The two most common perceived barriers to the implementation of LI-RADS were radiologists’ lack of familiarity with the guidelines and non-utilisation of LI-RADS by other clinical specialities involved in patient care. Indeed, implementation of any new diagnostic guideline in institutional practice, particularly for a complex condition such as HCC, would require in-depth discussion and corroboration between radiologists and clinicians. For LI-RADS, adequate attention should be paid to harmonising the understanding of the likelihood of HCC and treatment approaches to various categories of lesions, to ensure appropriate and effective multidisciplinary management of HCC, which has shown to improve clinical outcomes.⁽¹⁴⁾

Based on our findings, we propose the following for wider adoption of LI-RADS: (a) consensus to use LI-RADS among abdominal radiologists should be achieved to ensure consistent reporting; (b) abdominal radiologists need to be familiar with the guidelines and recommendations proposed in LI-RADS – educational resources on LI-RADS are readily available on the ACR website; and (c) discussions between radiologists and referring clinical

disciplines to familiarise each other with management approaches based on institutional resources and expertise.

One of the study limitations is the small absolute sample size. Our 47 survey responses represent 6.2% of the total number of medical oncologists, gastroenterologists, interventional radiologists and general surgeons in Singapore. Unfortunately, we were not able to accurately estimate the total number of specialists who actually manage HCC patients on a routine basis. In fact, we would expect that the minority would be treating HCC patients as part of a multidisciplinary team; for instance, there are only 41 hepatobiliary surgeons out of 400 general surgeons. Thus, our sample population would be expected to be significantly larger than 6.2%. Furthermore, we surveyed a disproportionately small number of clinicians (6.4%) from the private sector, which accounts for approximately 30% of the relevant clinical specialties that we surveyed (specifically, gastroenterology, general surgery, interventional radiology, medical oncology).⁽¹⁵⁾ That said, the majority of specialist care in Singapore resides in the public sector,⁽¹⁵⁾ where the survey findings could apply.

As the survey was anonymous and on a voluntary basis, there could have been sampling bias towards clinicians who were familiar with LI-RADS. Clinicians unfamiliar with LI-RADS may have opted not to participate in the survey. Nonetheless, we designed the survey to be as simple and self-explanatory as possible in order to encourage clinicians who have minimal experience with LI-RADS to provide feedback. Questions pertaining to the respondents' familiarity with LI-RADS also included a spectrum of options for respondents to select based on how confident they were in their knowledge of LI-RADS. Open-ended options were also available for Questions 6–8 as well as Question 18 to allow for personalised feedback.

In conclusion, there is broad agreement among clinicians that CT and MRI LI-RADS can be effective tools in communicating the probability of HCC in at-risk patients. The majority of clinicians also found that LI-RADS has a positive impact in communication among the

various stakeholders including patients, and standardising management. Our survey findings are encouraging in that our local specialists' practices seek to be aligned to international best practices. However, this adoption of LI-RADS will require efforts in education and collaboration between referring clinicians and their radiologists.

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APPENDIX

Dear colleagues,

We are a group of abdominal radiologists from who are interested in learning about the clinician's experience with LI-RADS, a reporting guideline used in the characterisation of observations in patients who are at risk of hepatocellular carcinoma (HCC).

The main objectives of the following survey are to:

1. Explore the type of guidelines used in various institutions
2. Determine clinician's receptiveness to LI-RADS
3. Quantify clinicians understanding of LI-RADS categories
4. Learn about barriers in implementing LIRADS

Through this survey, we hope to gain a better insight into your concerns and preferences so that we can work towards more relevant and concise reporting in order to improve inter-disciplinary communication and patient care.

The survey is anonymous and consists of 17 questions. It should take about 15 minutes to complete. We thank you in advance for your participation.

1. What is your current appointment?
 - Associate Consultant
 - Consultant
 - Senior Consultant
 - Other
2. How many years have you been practicing as a specialist?
 - 0 - 5 years
 - 6 - 10 years
 - 11- 15 years
 - 16 years or more
3. What is your speciality?
 - Gastroenterology
 - Hepatobiliary Surgery
 - Interventional Radiology
 - Medical Oncology
 - Other
4. Where do you practice?
 - Government or university hospital
 - Private practice
5. How often do you attend multidisciplinary meetings for liver tumours?
 - Not at all

- Once a month
- Twice a month
- 3 or more times a month

6. Which of the following reporting guidelines for HCC are you aware of? (check all that apply)

- LI-RADS
- APASL
- EASL
- AASLD (prior to merging with LIRADS 2018)
- OPTN
- None of the above
- Others

7. What reporting guideline for HCC does your institution currently use?

- LI-RADS
- APASL
- EASL
- AASLD (prior to merging with LIRADS 2018)
- OPTN
- None
- Not sure
- Others

8. Do you have a preferred guideline for characterisation of liver lesions?

- LI-RADS
- APASL
- EASL
- AASLD (prior to merging with LIRADS 2018)
- OPTN
- I do not have a guideline preference
- Others (please specify)

9. How familiar are you with LI-RADS?

- Very familiar (aware of major diagnostic criteria required for each LI-RADS score as well as implications of LI-RADS score)
- Somewhat familiar (aware of broad categories of LI-RADS 1-5 but not the inclusion criteria)
- I do not know how LI-RADS is structured

10. Are you aware that there is separate LI-RADS algorithm for lesions that have undergone locoregional therapy?

- I am aware and know that it is classified according to whether the lesion is viable or not
- I am aware of its existence but do not know how it is used
- I do not know that there is separate algorithm

11. What percentage of CT/MRI studies performed for patients at-risk of HCC in your institution use LI-RADS?

- None
- 1-25%

- 25-50%
- 50-75%
- More than 75%

12. Do you prefer radiology reports for multiphasic CT/MRI for HCC to include the LI-RADS score?

- Yes, I want the LI-RADS score to be mentioned
- I am neutral, I do not mind the LI-RADS score being mentioned but I do not need it either
- I do not want the LI-RADS score to be mentioned.

13. What do you think is the probability of HCC in an observation classified as LR-3?

- Very low likelihood (0-25%)
- Low likelihood (25-50%)
- Moderate likelihood (50-75%)
- High likelihood (more than 75%)

14. What do you think is the probability of HCC in an observation classified as LR-4?

- Very low likelihood (0-25%)
- Low likelihood (25-50%)
- Moderate likelihood (50-75%)
- High likelihood (more than 75%)

15. How effective is LI-RADS in communicating the following information?

- Whether an observation is definitely HCC

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Whether an observation is probably HCC

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Whether an observation has an intermediate probability of malignancy

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Whether an observation being probably or definitely malignant, but not specific for HCC

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Presence of a malignant neoplasm invading adjacent vasculature

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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16. How effective is LI-RADS in the following scenarios?

- Facilitation of MDT discussion

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Facilitation in treatment making decisions

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Communication of results with patients

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Communication with other specialities

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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- Communication with different hospitals

1 (not effective)	2 (somewhat effective)	3 (effective)	4 (very effective)
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17. Would you adopt the radiology report recommendation for subsequent management based on the LI-RADS score? Refer to attached image for guidance.

Management Suggestions for Untreated Observations (taken from LI-RADS v2018 CT/MRI Manual, 11-4)

LI-RADS Dx Category	Suggested Management
No observation	<ul style="list-style-type: none"> • Return to routine surveillance at standard time interval (usually 6 months). • Alternative multiphase imaging (usually ≤ 6 months).
LR-NC	<ul style="list-style-type: none"> • Repeat diagnostic imaging (suggested option in most cases if the technical limitation leading to a non-categorizable assignment can be resolved) (usually ≤ 3 months). • Alternative diagnostic imaging (suggested option if imaging with alternative modality or alternative contrast agent is reasonably likely to confer diagnostic advantage) (usually ≤ 3 months). • Multidisciplinary discussion (suggested option if no alternative imaging is appropriate).
LR-1	<ul style="list-style-type: none"> • Return to routine surveillance at standard time interval (usually 6 months).
LR-2	<ul style="list-style-type: none"> • Return to routine surveillance (suggested option in most cases) at standard time interval (usually 6 months). • Repeat diagnostic imaging (suggested option if repeat diagnostic imaging is considered beneficial in the radiologists' judgment) (usually ≤ 6 months). • MDD for individualized workup (suggested option if such discussion is likely to be beneficial in the radiologist's judgment).
LR-3	<ul style="list-style-type: none"> • Repeat diagnostic imaging in 3-6 months (suggested option in most cases). • Alternative diagnostic imaging in 3-6 months (suggested option if imaging with alternative modality or alternative contrast agent is reasonably likely to confer diagnostic advantage). • MDD for individualized workup (suggested option if such discussion is likely to be beneficial in the radiologist's judgment or if such discussion is required for LR-3 by institutional guidelines).
LR-4	<ul style="list-style-type: none"> • MDD for individualized workup and possible treatment (suggested option in most cases), which may include imaging, biopsy, or occasionally treatment without biopsy. • Repeat or alternative diagnostic imaging in ≤ 3 months.
LR-5	<ul style="list-style-type: none"> • MDD for staging and individualized treatment. Biopsy is not needed to confirm the diagnosis of HCC but may be obtained in some settings (e.g., for clinical trials requirements or molecular characterization).

Based on the above,

- I would follow the recommendation for subsequent management and/or surveillance
- I would not follow both management and surveillance recommendations

18. What are some of the perceived difficulties in implementing LI-RADS in your institution? (check all that apply)

- Radiologists not familiar with using LI-RADS
- Personal unfamiliarity with LI-RADS
- Other specialities involved with patient care not using LI-RADS (hepatology, oncology, transplant surgery)
- Preference for other guidelines
- LI-RADS terminology is too complex and restrictive
- Inter-observer variability in lesion characterisation and hence scoring
- Management guidelines proposed by LI-RADS does not complement my current institution's practices.
- LI-RADS is not sensitive enough for our local context
- Others (please specify)