



# Clinicians and surgeon survey regarding current and future versions of CT/MRI LI-RADS

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## Abstract

**Purpose** To determine preferences of clinicians and surgeons regarding radiology reporting of liver observations in patients at risk for hepatocellular carcinoma (HCC).

**Methods** Members of the American College of Radiology Liver Imaging and Data Reporting System (LI-RADS) Outreach & Education Group (30 members) as well as Society of Abdominal Radiology Disease-Focused Panel on HCC diagnosis (27 members) created and distributed an 18-question survey to clinicians and surgeons, with focus on preferences regarding radiology reporting of liver observations in patients. The survey questions were directed to physician demographics, current use of LI-RADS by their local radiologists, their opinions about current LI-RADS and potential improvements.

**Results** A total of 152 physicians responded, 66.4% (101/152) from North America, including 42 surgeons, 81 physicians and 29 interventional radiologists. Participants were predominantly from academic centers 83% (126/152), while 13.8% (21/152) worked in private/community centers and 3.2% (5/152) worked in a hybrid practice. Almost 90% (136/152) of participants preferred the use of LI-RADS (compared to nothing or other standardized reporting systems; OPTN and AASLD) to communicate liver-related observations. However, only 28.5% (43/152) of participants input was sought at the time of implementing LI-RADS in their institutions. Fifty-eight percent (88/152) of all participants found standardized LI-RADS management recommendations in radiology reports to be clinically helpful. However, a subgroup analysis of surgeons in academic centers showed that 61.8% (21/34) prefer not to receive standardized LI-RADS recommendations.

**Conclusions** Most participants preferred the use LI-RADS in reporting CT and MRI examination. When considering inclusion of management recommendations, radiologists should consult with their referring physicians, as preference may differ.

**Keywords** Standardization · LI-RADS · Survey · Surgeons · Clinicians

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## Introduction

Hepatocellular carcinoma (HCC), the most common primary liver tumor, has imaging characteristics allowing for a non-invasive definite imaging diagnosis, without the need for pathologic confirmation in most instances [1, 2]. Patients at high risk for HCC are often treated based on imaging alone, making accurate imaging diagnosis imperative [3]. The unique role of imaging in the diagnosis of HCC spurred the development of a standardized system of performing, interpreting and reporting of the imaging of patients at high risk of developing HCC. Liver Imaging Reporting and Data System (LI-RADS) was developed to help standardize the diagnosis and treatment of HCC by providing a common language among radiologists, general practice physicians, sub-specialty physicians, and other health care providers. In doing so, the aim is to improve interpretation, communication and ultimately, improve patient care.

LI-RADS is a dynamic system that is regularly updated as knowledge and evidence expands [4]. The latest LI-RADS version was released in 2018, shortly after the 2017 version release [5, 6]. This seemingly swift update signified the unification of LI-RADS with the 2018 American Association for the Study of Liver Diseases (AASLD) clinical practice guidelines [5–7]. LI-RADS will continue to have regularly scheduled updates, allowing for the system to improve and incorporate advances in imaging techniques, evidence-based knowledge, and user feedback, striving for broader integration into clinical practice and overall improvement in patient care.

LI-RADS was primarily developed by radiologists. However, management of HCC is multidisciplinary and also differs across institutions. There is lack of data regarding acceptance of LI-RADS by various medical specialties. Additionally, there is a lack of data regarding its use in different settings such as academic versus private practice/community hospital settings. As LI-RADS is a living diagnostic system, data are required regarding its use for fine-tuning and incorporation in future versions.

The aim of the survey was to seek the opinions of clinicians and surgeons on LI-RADS, including its benefits and shortcomings in the diagnosis and management of liver observations. Therefore, we directed our survey to healthcare providers involved in management of patients at risk of HCC, who have also trained and or currently practicing in North America.

## Methods

### Survey design

Members of the American College of Radiology (ACR) LI-RADS Outreach & Education Committee (LI-RADS O&E, 30 members) as well as the Society of Abdominal

Radiology Disease-Focused Panel on HCC diagnosis (SAR-DFP: HCC, 27 members) developed and distributed a survey to clinicians and surgeons who are involved in management of HCC. Although LI-RADS also incorporates ultrasound and contrast-enhanced ultrasound components, the current survey specifically pertained only to the use of CT and MRI of the liver in diagnosis of HCC. Members of each group submitted questions, which were vetted and edited by three radiologists (AK, KE, RM). Subsequently, this was further edited and reviewed in an iterative fashion by numerous other members of the groups over numerous emails and one conference call to ensure the questionnaire was relevant, free of bias, and that the language used would be easily interpreted by the participants. Questions were vetted by committee members to be non-leading, and sequentially ordered so that common topics were grouped together. The final survey consisted of 18 questions: three questions related to the respondent's demographics (physician specialty, geographic location of work, and work setting (academic vs community/private practice)), six related to the current reporting practice at their institution and perceived value of the radiologist as part of the multidisciplinary team (MDT), three related to their opinions about impact of LI-RADS on patient management, one related to LI-RADS management guidelines, one related to overall utilization, one related to tumor response algorithm and two related to future recommendations (See Appendix 1 for detailed list of questions). The majority of the questions were multiple-choice, some allowing only a single choice and others allowing more than one option to be chosen. There were also text comments sections available for explanation of responses, which were optional to fill out. Frequency related multiple-choice answer options consisted of defined percentages as choices to reduce subjectivity of answers. An introductory paragraph was presented to describe the purpose of the survey to the participants. Clear instructions were provided to ensure questions were answered in a manner that best represented the survey participants current practice and opinions.

### Survey participants and delivery

All members of the LI-RADS O&E and SAR-DFP: HCC diagnosis groups were asked to share the survey with their colleagues at work and throughout their community by email. The survey targeted physicians involved in the care of patients at high risk for HCC. This included gastroenterologists, hepatologists, oncologists, hepatobiliary surgeons, general surgeons, transplant surgeons, general internists, interventional radiologists, pathologists and family physicians. Different types of practices included academic, transplant centers, private/community hospital and non-hospital-based practices, and government hospitals. The survey was created and hosted utilizing a commercial website (Survey

Monkey, USA). The survey link was shared on the SAR-DFP and ACR Twitter accounts, both managed by LI-RADS O&E group members. Seven members of the LI-RADS O&E and SAR-DFP: HCC diagnosis groups who practice in a community/private setting distributed the survey to community physicians. One gastroenterologist and two liver transplant surgeons who are members of the groups distributed the survey to their colleagues and association members (e.g., American Gastroenterological Association, American Society of Transplantation and American Association for the Study of Liver Disease). Some of the participants reached had done prior training in the United States. The survey remained open for approximately 9 months (June, 2018–February, 2019) with a few reminders sent during this time span. No incentives were offered for participants. Confidentiality and anonymity of the participants was maintained.

### Data collection and analysis

Responses to survey questions were recorded by frequency and percentage in the commercial survey website (Survey Monkey, USA) for each question in a blinded manner. Selected responses were analyzed to compare the input of various subgroups. The data were then collated into an Excel spreadsheet (version 16 Microsoft, USA) for analysis.

## Results

### Participant demographics

A total of 152 physicians participated in this survey, 66.4% (101/152) from the United States representing 28 states, 24.3% (37/152) from Canada representing 6 provinces, and 9.2% (14/152) from countries outside of North America. There were 14 participants from countries outside of North America, 57.1% (8/14) were from Australia, 28.6% (4/14) were from India, 7.1% (1/14) was from Japan, and 7.1% (1/14) was from Thailand. The entire survey was completed by 95.4% (145/152) of participants. Average time taken to complete the survey was 8.0 min. The estimated response rate could not be determined since the survey was distributed by various committee members, as well as through social media.

Survey participants were from various specialties, including 27.6% (42/152) gastroenterologists, 27.6% (42/152) surgeons, 19.1% (29/152) interventional radiologists, 13.8% (21/152) hepatologists, 5.3% (8/152) medical oncologists, 4.6% (7/152) radiation oncologists, 1.3% (2/152) internal medicine physicians and 0.6% (1/152) family physician. The 42 surgeons were further categorized as 54.8% (23/42) hepatobiliary, 33.3% (14/42) transplant, 7.1% (3/42) general, and 4.8% (2/42) surgical oncology surgeons.

**Table 1** (Q2 & Q3): Demographics of participants

Data collected about survey responders	Result (total 152)
Academic centers	126 (82.8%)
Community/private practice/Government or mixed	26 (17.1%)
Surgical specialty	42 (27.6%)
Clinical or affiliated specialty	110 (72.3%)
Participants who completed survey	Yes: 145 (95.4%) No: 7 (4.6%)
Country of current practice	USA 101 (66.4%) Canada 37 (24.3%) Other 14 (9.2%)

**Table 2** (Q5): LI-RADS reports received by responder clinicians and surgeons by work-place environment

Responders characteristics	Percentage receiving radiology reports using LI-RADS
All responders in this survey	134/152 (88.2%)
Those working in academic centers/academic transplant centers	110/124 (88.7%)
Those working in community/private/mixed practice/government	24/28 (87.5%)

Most participants 83% (126/152) worked in an academic center. Of this group, 61.1% (77/126) worked in liver transplant centers. 13.8% (21/152) participants were from community/private practice, and 3.2% (5/152) worked in a mixed academic/community practice (Table 1).

### Reporting practice and radiologist value

Eighty-eight percent (134/152) of survey participants worked in a center where the radiology department currently uses LI-RADS (Table 2). Of all survey responders, 89.5% (136/152) preferred receiving reports incorporating LI-RADS (Table 2). Other responders indicated a preference for one or more of the other diagnostic imaging categorization systems: OPTN in 7.9% (12/152) and AASLD in 17.8% (27/152). Six percent (9/152) participants work in centers that do not utilize a standardized system for the reporting of liver observations in patients at risk for HCC in the radiology reports.

Of 134 participants where the radiology department uses LI-RADS, only 28.5% (43/151) were consulted prior to their radiology departments adopting LI-RADS to determine if they were receptive to including LI-RADS in their patient's radiology reports. Only 63% (85/135) of participants working in centers using LI-RADS estimated that >90% of their radiology reports included LI-RADS category, while 16.3% (22/135) estimated that 60–90% of their reports included

LI-RADS categories. Approximately 10% (17/152) of participants were not able to estimate frequency of LI-RADS is used in radiology reports. Lastly, almost all survey participants, 97% (148/152) affirmed the added value of having a diagnostic radiologist present at multidisciplinary meetings.

### Impact on patient management

As part of the survey, we asked clinicians and surgeons about their perceived impact of LI-RADS on patient management, communication of findings among specialists (inter-speciality) and to patients. There was agreement among most participants 91% (137/150) that LI-RADS is “very helpful” in providing clear language to clinicians if a patient has HCC observation, and 81% (122/150) felt the system is “very helpful” when patients have more than one HCC observation. Conversely, <5% (6/150) thought it was not helpful. There was less robust agreement regarding the helpfulness of LI-RADS in reporting tumor in vein 76.2% (114/150) and other non-HCC neoplasms (using a specific “LR-M” category) 64.7% (97/150) [4]. The reasons for the answers were variable and included issues of consistency and accuracy, particularly for the tumor in vein (Table 3).

Eighty-eight percent (132/150) thought that LI-RADS positively impacted their treatment decisions. Also, most participants believed that LI-RADS helped them to determine transplant eligibility and priority 77.9% (116/149). An overall positive impact of LI-RADS on communication among healthcare providers or between clinicians and

patients was reported. Specifically, 80.6% (121/150) indicated that LI-RADS made communication with patients regarding their findings easier, 90% (135/150) felt LI-RADS facilitated communication between healthcare providers, and 83.8% (125/149) indicated that LI-RADS made referrals/ letters to other hospitals easier and clearer (Table 4).

### Management guidelines

Over half of participants, 57.8% (88/152) appreciated LI-RADS standardized, explicit management recommendations. However, when responses were analyzed by subgroups (surgeons vs non-surgeons and academic vs non-academic), we identified that 57.5% (24/42) of all surgeons and 61.8% (21/34) of surgeons in academic practice preferred that LI-RADS not to provide any management recommendations (Table 5). They explained their opposition by comments including “LI-RADS does not integrate other patient factors”, “LI-RADS does not take into account the severity of liver disease”, “does not leave enough flexibility to clinicians to decide management” and “management is too complex and depends on local expertise, better decided in MDT (multidisciplinary treatment meetings)” (Table 5). Furthermore, nearly two-third of all participants 64% (93/145) manage LI-RADS 4 category similar to LI-RADS 5, this was explained by some participants to be related to similar factors as their opposition to strict standardized management recommendation.

**Table 3** (Q10): Clinician and surgeon responder results regarding utility of LI-RADS in radiology reports and its effect on various aspects of communication (150 of 152 answered this question) (1-not helpful for communication, 5-very helpful for communication)

Perceived impact	1	2	3	4	5	Total
Communication of whether your patient has HCC	1 (0.7%)	4 (2.7%)	8 (5.3%)	48 (32.0%)	89 (59.3%)	150
Communication of how many HCC lesions your patient has	6 (4.0%)	6 (4.0%)	16 (10.7%)	44 (29.3%)	78 (52.0%)	150
Communication of whether your patient has a malignant neoplasm invading a vein	4 (2.7%)	8 (5.3%)	24 (16.0%)	49 (32.7%)	65 (43.3%)	150
Communication of whether your patient may have a malignant neoplasm other than HCC	3 (2.0%)	11 (7.3%)	39 (26.0%)	46 (30.7%)	51 (34.0%)	150

**Table 4** (Q11): Clinician and surgeon results regarding use LI-RADS in radiology reports and the perceived impact on and patient care

Perceived impact	1	2	3	4	5	Total
Determining liver transplant eligibility and prioritization	0 (0.0%)	4 (2.7%)	29 (19.5%)	50 (33.6%)	66 (44.3%)	149
Making treatment decisions	1 (0.7%)	1 (0.7%)	16 (10.7%)	57 (38.0%)	75 (50.0%)	150
Communicating results with patient	1 (0.7%)	5 (3.3%)	23 (15.3%)	53 (35.3%)	68 (45.3%)	150
Communication with different service lines involved with patient care (hepatology, oncology, transplant surgery, interventional radiology)	1 (0.7%)	0 (0.0%)	14 (9.3%)	52 (34.6%)	83 55.3%	150
Communication with different hospitals (e.g., transplant centers)	1 (0.7%)	1 (0.7%)	22 (14.8%)	51 (34.2%)	74 (49.7%)	149
Other	0 (0.0%)	1 (3.1%)	15 (46.9%)	5 (15.6%)	11 (34.4%)	32

(1-not helpful for communication, 5-very helpful for communication). (150 of 152 responded to this question)

**Table 5** (Q13): Preference of responder physicians for use of LI-RADS standardized recommendations

Work environment	# responders	WANT recommendations (%)	Do NOT want recommendation (%)
Academic centers	124	51.6	46.0
Community/private practice centers/mixed/government	28	83.3	12.5
Surgeons regardless of work type	42	42.5	57.5
Clinicians (non-surgical) regardless of work type	81	67.4	28.3
Surgeons in academic centers	34	38.2	61.8
Surgeons in community/private practice/mixed	5	60	40.0
Clinicians in academic centers	70	60	35.7
Clinicians in community/private practice/mixed	19	89.5	5.3
Interventional radiology	29	85	15

## Overall utilization

We also sought the opinion of our participants on why LI-RADS was not currently implemented globally. Nearly two-third of participants 68.6% (103/150) believed radiologists are not adopting the system, while less than half of participants thought either radiologists are inconsistent in using the system 47.3% (71/150), or clinicians not integrating LI-RADS in their patients management 42.7% (64/150). Fewer participants thought it is due to preference of other guidelines 36% (54/150) or due to LI-RADS complexity 12% (18/150) and too many terminologies used in the system 11.3% (17/150).

## Treatment response

Responses regarding the LI-RADS tumor response algorithm found that 42.4% (62/146) of participants found the algorithm to be comprehensive, satisfying all their clinical needs. Slightly fewer participants, 41.1% (60/146) thought the algorithm was useful for only certain subtypes of locoregional therapies (e.g., radiofrequency ablation or microwave ablation) but challenging to apply to other therapies (e.g., external radiation beam therapy or catheter-based therapies). Four participants provided free text responses as “post Y-90 changes” being incompletely assessed by the system. Also, 3 of participants specifically suggested in the comments section that a treatment-specific response assessment would be more clinically beneficial than having a single treatment categorization system for all types of therapies. Despite the perceived shortcomings of the treatment response algorithm, only 16.4% (24/146) individuals felt that there is no need for a treatment response algorithm in radiology reports in their practice.

## Future recommendations

Regarding expectations for future LI-RADS versions, over half of participants 65.3% (96/147) wanted incorporation of clinical information into the management recommendations of LI-RADS categories. Specifically, participants expressed a desire for LI-RADS categories 4 and 5 to incorporate clinical data so that tailored management recommendations could be provided for individual patients. For tumor response algorithm, 41.1% (60/146) of participants hoped to have a specific algorithm for specific treatments (e.g., thermal ablation versus catheter-based ablation versus radiotherapy). Nearly 25% (35/147) of responses thought having a smart phone application to help assign a final LI-RADS category and would be a great addition. Approximately 14% (20/147) of participants thought LI-RADS needed to be simplified in subsequent versions. There was no definite consensus on how frequently LI-RADS should be updated. However, 61.6% (93/151) thought every 2 or 3 years is a reasonable interval for updates. Finally, 70.3% (103/147) of participants wanted to see outside reports (referring centers) use LI-RADS more often to describe liver findings for patients referred to their centers.

## Discussion

LI-RADS is a dynamic “living” system that standardizes the terminology, technique, interpretation, reporting, and data collection of liver observations in patients at high risk for developing HCC. The term “living” is used to indicate that there are active committees and subcommittees related to various aspects of LI-RADS, which continue working between routinely planned updates to the system, and update the system based on current data published in peer-reviewed literature. Through standardization, LI-RADS aims to

improve communication between health care workers caring for these high-risk patients, specifically between diagnostic radiologists and referring physicians.

The goal of this survey was to use the data collected to direct improvements to the overall system, specifically LI-RADS radiology reports, which in turn, will ultimately improve patient care and serve as a guide to future versions of LI-RADS, including the currently-planned version 2021 LI-RADS update. It is important to note that this survey was sent out before the official adoption of LI-RADS into the AASLD statement on the diagnosis HCC [8].

Although 88.1% (134/152) of the physicians indicated that their institutions utilize LI-RADS, at least 32% (49/152) of participants responded that less than 90% of radiology reports had specific LI-RADS categories in the final report. This indicates inconsistency in its use, and it may be possible that LI-RADS was used only for the baseline examination and not for subsequent follow-up or post-treatment examination. This specific information however was not evaluated by the survey.

A majority of participants believe that LI-RADS provides a common language that can be for multidisciplinary meetings, research purposes, and management guidelines. Furthermore, LI-RADS was reported to aid communication to healthcare providers who less frequently encounter patients at high-risk for HCC. This may be particularly important for patients in rural areas, who may be referred to larger centers for confirmatory diagnosis and treatment but subsequently return to their local provider for their follow-up care.

As per the survey results, LI-RADS is felt to positively impact patient care and decision-making, especially in cases of liver transplant eligibility and other HCC therapies. While the LI-RADS management recommendations may be suitable for the majority of cases, it may not always be applicable to patients seen in quaternary care academic centers where complex clinical factors may impact decision-making. These clinical characteristics are not currently incorporated into the LI-RADS algorithm and perhaps should be considered for future versions. Until such time when these factors get incorporated into the LI-RADS system, radiologists should closely work with clinicians and establish a consensus regarding incorporating specific information in their reports.

Groups such as the LI-RADS O&E and SAR HCC Diagnosis-DFP should continue their efforts in educating fellow radiologists about how to use LI-RADS and why it is important for patient care. Once radiologists implement the system in their institutions of practice, local clinicians will learn the system. As only 28.5% (43/151) of participants indicated that their input was sought at the time the radiology department instituted LI-RADS, there is opportunity for improved communication between radiologists and referring clinicians prior to implementation of LI-RADS. Of note, clinicians and surgeons value radiologists' input at multidisciplinary

meetings, which may serve as a good forum to introduce LI-RADS, provide answers to commonly asked questions about LI-RADS, and create familiarity with the terminology commonly used in the reporting system.

Limitations to the study included potential sampling bias toward academic centers and potentially towards “LI-RADS advocates” who work closely with participants. If a clinician was not familiar with LI-RADS, they may have chosen not to participate. We did not specifically ask the participants to indicate what volume of imaging reporting they performed which specifically applies to LI-RADS. Only small number of our survey participants practice in community/private practice, thus their response may have been less represented in this survey. Future surveys dedicated specifically at community/private practice radiology may have value. The extent of distribution of the survey and response rate cannot be accurately assessed because the survey was distributed through a combination of email and social media from multiple sources. Additionally, the survey did not ask about Ultrasound or Contrast-Enhanced Ultrasound LI-RADS, which were introduced by the ACR shortly before the development of this survey.

## Conclusions

In the cohort of physicians who completed the 18-question survey about radiology reports for patients at risk for HCC, we found that the majority of physicians appreciate having LI-RADS utilized in the radiology report and that that LI-RADS is having a positive impact on communication among healthcare providers and between clinicians and patients. The LI-RADS Tumor Response working group will use the information from this survey to address challenges in assigning LI-RADS treatment response categories, especially for other radiation-related therapies, and to provide improved value in LI-RADS reports for patients who have undergone various locoregional therapies for HCC. Overall, the information reported in this survey may influence the content, guidance, and approach to dissemination of the next LI-RADS version after consultation of clinical stakeholders.

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## Compliance with ethical standards

**Conflict of interest** All authors declare that they had full access to all the data in this study. The authors take complete responsibility for the integrity of the data and the accuracy of the data analysis. Dr Kielar is a consultant for Leap Biomedical systems and had GE grant ended in 2018. Dr Chernyak is a consultant for Bayer pharmaceutical and

life sciences company. Dr Robert Marks: The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Dr Robert M Marks is a military service member. This work was prepared as part of my official duties. Title 17, USC, §105 provides that “Copyright protection under this title is not available for any work of the United States Government.” Title 17, USC, §101 defines a U.S. Government work as a work prepared by a military service member or employee of the U.S. Government as part of that person’s official duties. Remaining authors declare no conflict of interest.

## Appendix 1: Introductory statement

Dear Colleagues: As radiologists we are interested in adding value to our reports which we hope will be of help to you in your practice. This survey has been created by the LI-RADS team and you are being asked to answer these 18 questions so that future LI-RADS versions may be of optimal use to you. Thank you in advance for your time in answering this short survey.

## Appendix 2

List of all questions involved in the survey.

Q1: What is your specialty?

- Family practice
- Internal medicine
- Gastroenterology
- General Surgery
- Hepatobiliary Surgery
- Transplant Surgery
- Pathology
- Interventional Radiology
- Other (please specific)

Q2: What is your work environment?

- Academic liver transplant center
- Academic non- liver transplant center
- Community hospital/private practice
- Independent health facility
- Mixed practice
- Government
- Other (please specify)

Q3: What country and state (or province) do you work in? (free text answer)

Q4: Does your department currently use LI-RADS?

- Yes
- No

Q5: Which is your preferred system to use for the diagnosis/categorization of any liver lesion? (check all that apply)?

- LI-RADS
- OPTN
- AASLD
- I do not use any system
- I use a different system (specify)

Q6: Was your input/opinion sought prior to having the radiology department start using LI-RADS?

- Yes
- No

Q7: With regard to multiphase CT or MRI done for HCC imaging at your institution, what percentage of the radiology reports use LI-RADS?

- 0%
- 1–10%
- 11–40%
- 41–60%
- 61–90%
- > 90%
- Don’t know

Q8: Do you find the presence of a diagnostic radiologist at your multidisciplinary discussion/case conference valuable? Why?

Q9: With regard to multiphase CT or MRI done for HCC imaging at your institution, do you prefer radiology reports with LI-RADS compared to those without? (free-text also available)

- Yes
- No
- Not sure

Q10: Rate how LI-RADS use affects radiology reports in the following areas (scale of 1–5; 1 = not helpful; 5 = extremely helpful). Can use same number more than once.

- Communication of whether your patient has HCC
- Communication of how many HCC lesions your patient has
- Communication of whether your patient has a malignant neoplasm invading a vein
- Communication of whether your patient may have a malignant neoplasm other than HCC
- Other

Q11: Rate how LI-RADS affects various aspects of patient care (scale 1–5; 1 = negatively affects patient care; 3 = neither positive nor negative effect on patient care; 5 = positively affects patient care). Can use same number more than once.

Determining liver transplant eligibility and prioritization

- Making treatment decisions
- Communicating results with patient
- Communication with different service lines involved with patient care (hepatology, oncology, transplant surgery, interventional radiology)
- Communication with different hospitals (e.g., transplant centers)
- Other

Q12: Do you manage LR-4 observations the same way you would manage LR-5?

- Always or almost always
- Sometimes (specify when)
- Never or almost never. Instead, I follow LI-RADS guidelines when something is categorized as LI-RADS-4 (short term surveillance, biopsy, and/or multidisciplinary discussion)

Q13: The latest versions of LI-RADS include standardized management recommendations for each category. What is your opinion regarding the provision of management recommendations in radiology reports?

- I appreciate radiology reports providing standardized recommendations
- I do not want radiology reports providing management recommendations

Q14: What are some of the barriers to implementing LI-RADS across the world (check all that apply):

- Radiologists not using LI-RADS
- Personal unfamiliarity with LI-RADS
- Other service lines involved with patient care not using LI-RADS (hepatology, oncology, transplant surgery, interventional radiology)
- Presence or preference of other guidelines (AASLD, OPTN, other country's guidelines)
- Radiology reporting of LI-RADS is inconsistent
- LI-RADS terminology is too complex
- There are too many LI-RADS categories

Q15: The new tumor response algorithm was designed as a first iteration to include imaging appearance of viable tumor, non-viable tumor or equivocal findings: this currently

applies to ALL locoregional therapies (though not systemic therapies such as chemotherapy, immunotherapy or most surgical interventions). With regards to the Tumor Response Algorithm, please choose the option that you feel best applies.

- This algorithm satisfies my needs as a clinician/surgeon
- I do not need a tumor response algorithm for assessing my patients post locoregional therapy
- This algorithm is only helpful for certain therapies and does not represent appearance of HCC post other types of locoregional therapies. Future iteration of tumor response should have specific algorithms for specific therapies
- Other (please specify)

Q16: What are aspects of LI-RADS you would like changed/improved? (check all that apply)

- Would like to see standardization of technique and lesion reporting from outside hospitals
- I feel sometimes lesions are categorized as LI-RADS 4, but clinical suspicion is high, and this sometimes prevents moving forward with treatment
- It would be easier to use if it were simplified
- I wish there were a way to better incorporate clinical suspicion for management of LI-RADS observations
- It would be helpful to have an App on a smart phone that could help radiologists characterize lesions and for clinicians/surgeons to understand the management implications more easily
- Other (please specify)

Q17: About how often do you think LI-RADS updates should take place (choose your preferred answer)

- Yearly
- Every 2 years
- Every 3 years
- Every 5 years
- Other (please specify)

Q18: Do you have any additional needs, related to patients at risk for HCC, which are not addressed by LI-RADS? (please write in comments section).

## References

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