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SPECIAL ARTICLE

Quality measures in HCC care by the Practice Metrics Committee of the American Association for the Study of Liver Diseases

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Abbreviations: AASLD, American Association for the Study of Liver Diseases; AFP, alpha-fetoprotein; BCLC, Barcelona Clinic Liver Cancer; LI-RADS, Liver Imaging-Reporting and Data System; LT, liver transplantation; MLTB, multidisciplinary liver tumor board; PMC, Practice Metrics Committee; PRO, patient-reported outcomes; US, ultrasound.

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Abstract

The burden of HCC is substantial. To address gaps in HCC care, the American Association for the Study of Liver Diseases (AASLD) Practice Metrics Committee (PMC) aimed to develop a standard set of process-based measures and patient-reported outcomes (PROs) along the HCC care continuum. We identified candidate process and outcomes measures for HCC care based on structured literature review. A 13-member panel with content expertise across the HCC care continuum evaluated candidate measures on importance and performance gap using a modified Delphi approach (two rounds of rating) to define the final set of measures. Candidate PROs based on a structured scoping review were ranked by 74 patients with HCC across 7 diverse institutions. Out of 135 measures, 29 measures made the final set. These covered surveillance (6 measures), diagnosis (6 measures), staging (2 measures), treatment (10 measures), and outcomes (5 measures). Examples included the use of ultrasound (± alpha-fetoprotein [AFP]) every 6 months, need for surveillance in high-risk populations, diagnostic testing for patients with a new AFP elevation, multidisciplinary liver tumor board (MLTB) review of Liver Imaging-Reporting and Data System 4 lesions, standard evaluation at diagnosis, treatment recommendations based on Barcelona Clinic Liver Cancer staging, MLTB discussion of treatment options, appropriate referral for evaluation of liver transplantation candidacy, and role of palliative therapy. PROs include those related to pain, anxiety, fear of treatment, and uncertainty about the best individual treatment and the future. The AASLD PMC has developed a set of explicit quality measures in HCC care to help bridge the gap between guideline recommendations and measurable processes and outcomes. Measurement and subsequent implementation of these metrics could be a central step in the improvement of patient care and outcomes in this high-risk population.

INTRODUCTION

Globally, HCC is the third leading cause of cancer-related death and the second leading cause of cancer-related years of life lost.[1,2] In the United States, HCC burden is substantial, with significant geographic, socioeconomic, racial, and ethnic variation.[3] International professional society guidelines emphasize that early detection and access to effective therapy are essential for improving HCC outcomes.[4-10] Specifically, the guidelines underscore the need for surveillance (e.g., abdominal ultrasound [US] with or without alpha-fetoprotein [AFP] among patients with cirrhosis), recommend use of select modalities for diagnosis (e.g., multiphasic CT or MRI), and endorse a multidisciplinary approach to management of patients with HCC.

Despite the wide dissemination of guidelines on how to screen, diagnose, and treat HCC, the application of guideline-concordant care is suboptimal.[11,12] For example, only 25%-50% of patients with cirrhosis receive surveillance for HCC every 6 months.[13-18] Multidisciplinary liver tumor boards (MLTBs), although recognized as important, are not effectively used and/or recommendations not implemented.[19,20] Only 20%

to 40% of patients with HCC receive any treatment, and as few as half of patients with HCC eligible for potentially curative treatments receive these therapies.[21-24]

The need to measure and improve quality of HCC care is important for several reasons. First, there is wide variation in the standards of HCC-related care across centers and regions in the United States.[20,25-28] Lack of adherence to common measures in HCC care may explain some of the delays in diagnosis, suboptimal access to curative treatment, and lower overall survival.[11,25,29] Data show that quality improvement efforts, such as HCC surveillance reminders or an MLTB, are associated with earlier diagnosis and shorter time to HCC treatment.[30-33] Identifying a core set of practice standards in HCC care is necessary. However, clinical guidelines do not specify components that can be easily monitored or tracked. Second, there is an increasing emphasis on value-based care, which incorporates care appropriateness, costs, and outcomes. Thus, a logical first step is a systematic measurement of care provided to patients along the HCC care continuum and establishing a framework for implementation of accepted measures. Third, identifying gaps in care allows for continuous quality improvement and serves as a relevant baseline for efforts to improve care.[34]

PURPOSE AND SCOPE

To address gaps in HCC care, the American Association for the Study of Liver Diseases (AASLD) Practice Metrics Committee (PMC) aimed to develop a standard set of process-based measures and patient-reported outcomes (PROs) along the HCC care continuum. With a goal of improving the care of patients with or at risk for HCC, the PMC used a modified Delphi approach to develop metrics that can be used by health care providers and systems to measure, track, and improve the quality of HCC care.

PATIENTS AND METHODS

Identification of the candidate quality metrics

We aimed to identify measures of quality of care provided to patients who are at high risk of developing HCC or who have been diagnosed with HCC (Figure 1). We used a predefined stepwise approach to identify a set of process and outcome measures that are clinically meaningful, have evidence demonstrating variation in clinical practice, and can be feasibly measured in quality improvement efforts. We followed a methodology similar to our prior approach for developing quality measures in cirrhosis.[35] We defined an outcome to be important if (1) it is important to patients or clinicians, (2) it is meaningful across multiple populations, and (3) it can help facilitate change and quality improvement.

PMC working group

The PMC members include adult and pediatric hepatologists from 12 academic centers across the United States, working in a variety of clinical settings, and with expertise in health services research and HCC care. The working group met monthly virtually and once in person between January and October 2019. The working group identified candidate process and outcomes measures for HCC care (either patients at risk for or with HCC) based on a structured literature review (2013-2018) of published clinical practice guideline recommendations, guidelines and guidance statements, and PMC member clinical experience.[5,8,9,36-43] Recommendations were then converted to process and outcome measures. Duplicate measures were identified and combined with care to preserve nonoverlapping recommendations as unique standalone measures. This method identified candidate process measures and candidate outcome measures that addressed the following domains: HCC surveillance, diagnosis, staging and treatment allocation, and modality (surgical resection, liver transplantation [LT], ablation, locoregional therapy, systemic therapy, and palliative care).

Multidisciplinary expert panel

We assembled a diverse multispecialty 13-member expert panel. It included eight hepatologists, two surgeons, two radiologists, and one palliative care specialist. Candidate measures underwent a two-round modified Delphi process. In the first round, each expert rated the candidate measures independently based on their importance and performance gap. In the second round, the experts' rating (both individual and group) for each measure was discussed and then rerated.

Premeeting rating (round 1)

Expert panel members were instructed to rate each candidate measure on two criteria using a nine-point Likert scale: importance and performance gap. The "importance" of a measure was defined by the following: (1) there is existence of strong scientific evidence demonstrating that compliance with a process measure improves health care outcomes (either directly or by reducing the risk of adverse outcomes), (2) the measure is closely connected with the outcome it impacts, and (3) the magnitude of the effect of performing the measure is large enough to be worth doing. We defined an

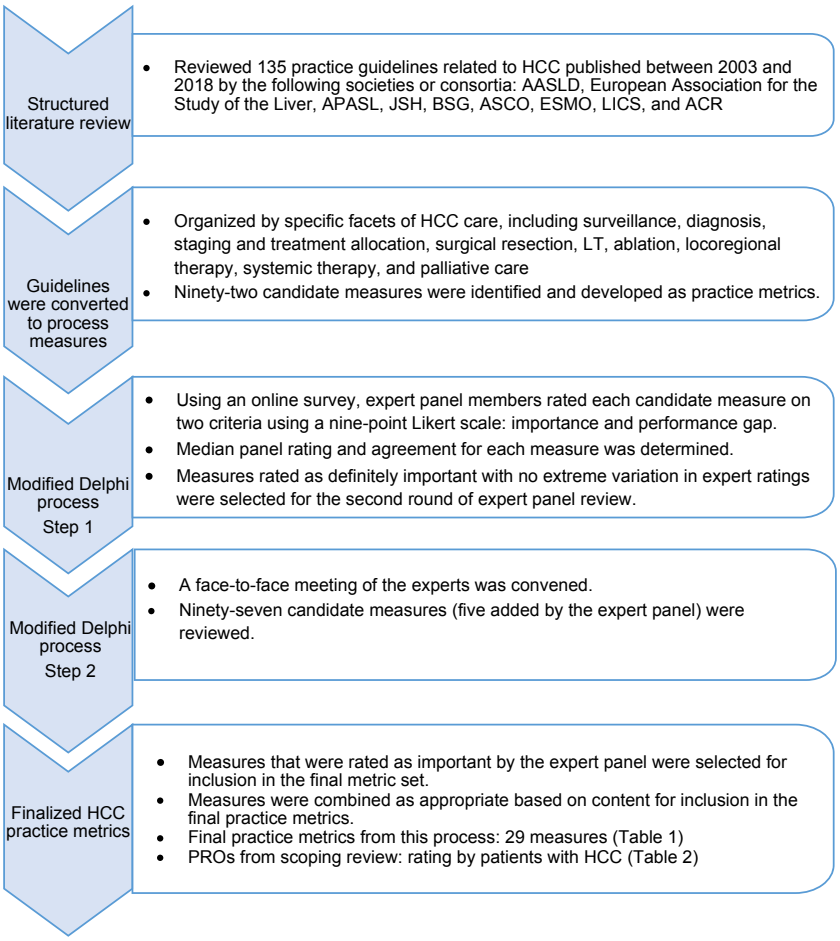

FIGURE 1 The stepwise approach followed to develop practice metrics in HCC care using a modified Delphi process. Abbreviations: ACR, American College of Radiology; APASL, The Asian Pacific Association for the Study of the Liver; ASCO, American Society of Clinical Oncology; BSG, The British Society of Gastroenterology; ESMO, European Society for Medical Oncology; JSH, Japan Society of Hepatology; LICS, London Integrated Cancer System

outcome to be important if it is meaningful to patients and clinicians and if it can help facilitate change and quality improvement. "Importance" was graded using a score ranging from 1 "not important at all" to 9 "extremely important." "Performance gap" was defined as the gap between optimal performance of each measure and current performance in clinical practice, with a score of 1 indicating "no gap" (care for all patients meets the current standards for all patients) and a score of 9 indicating "the largest gap" (care falls short of the current standards by a wide margin for all patients).

The PMC working group used the median panel rating and a measure of agreement for each measure for each criterion to identify the final set of measures completing the modified Delphi process. The working group relied on ratings of importance as the primary criterion to guide the measure-selection process and specifically selected measures if they were voted as definitely important (group median ≥ 7) with no extreme variation in expert ratings.[44,45] No extreme variation was defined as having more than 80% of the ratings in the 7-9 range, with none in the 1-3 range. This selection criteria process has been used widely to develop performance measures across several areas of medicine.[46-50] This step resulted in 92 candidate HCC quality metrics.

Face-to-face meeting (round 2)

An in-person meeting of the PMC members and the expert panel was convened in November 2019. The face-to-face meeting was moderated by members of the PMC working group. The meeting format and directives included (1) review of the scores for the "importance" and "performance gap" for each metric, (2) discussion to identify the reasons for variation, (3) revision of suboptimally worded measures for accuracy by consensus, (4) deletion of measures that were deemed problematic or irrelevant by consensus, and (5) identification of additional measures not identified and included in the list of measures that they reviewed. The resulting list of measures was reviewed by the members of the expert panel, who then rerated each measure for importance using the same nine-point scale. Measures were combined as appropriate based on content for inclusion in the final practice metrics.

PROs

The group recognized that the outcomes need to include measures that capture patients' assessment of their health status (PROs), including symptoms as well as physical, social, and mental functioning.[35,51,52] In a separate effort by the PMC, a scoping review of PROs in HCC was conducted by members of the PMC to identify a comprehensive set of PROs for inclusion in the candidate measures (published separately). The final list of PROs was reviewed by the PMC working group and 2 patient representatives. Thirteen candidate PROs were identified. Patients with HCC (unselected by race, sex, socioeconomic status, stage, and type of treatment) completed an anonymous survey rating the importance of each candidate PRO based on a five-point scale. In addition, patients with HCC were asked to identify the three most important symptoms/issues. The patients represented a convenience sample of all-comers to multidisciplinary HCC clinics with all stages of disease. In total, 74 patients from 7 institutions completed the survey. Requirement for informed consent was waived by the institutional review committee given anonymous survey data were used.

RESULTS

Candidate quality metrics

In total, 135 statements were examined, and through the process described, 92 candidate measures were identified and developed as practice metrics. The expert panel recommended 5 additional measures for a total of 97 candidate measures (Table S1). Of these, 71 were process-based and 26 were outcomes-based. These included measures in surveillance,[19] diagnosis,[24] staging and treatment,[28] and outcomes.[26]

Final process measures

Based on the modified Delphi process (2 rounds of rating), of the 97 measures, 73 measures had a median importance score of 7 or higher. Of these, 43 were excluded based on our definition of extreme variation. Twenty-eight measures were included, and 2 measures were combined based on content, leading to a final set of 29 measures (Table 1). These covered surveillance (6 measures), diagnosis (6 measures), staging (2 measures), treatment (10 measures), and outcomes (5 measures).

Surveillance measures

In total, six process measures can be used to assess the quality of care of patients with liver disease undergoing HCC surveillance. Each also had a large (median 7) gap in clinical care. The most important measures identified by the experts included the use of US with or without AFP every 6 months, the need for surveillance in certain populations with chronic hepatitis B (regardless of cirrhosis status), and the need for surveillance in patients with HCV and cirrhosis even after achieving sustained virologic response with treatment.

Diagnostic measures

Six diagnosis-related measures were felt to be important (median importance 8, gap 5-6). This included diagnostic testing for patients with a new elevation of AFP. The panel considered the use of the Liver Imaging-Reporting and Data System (LI-RADS) categorization as important for standardized description and diagnosis of liver lesions found by dynamic CT or MRI in patients undergoing HCC surveillance. Other measures included repeat dynamic imaging (with the same or different imaging modality) within 6 months for LI-RADS 3 lesions and MLTB review of LI-RADS 4 lesions.

Staging

There was broad support for the use of the Barcelona Clinic Liver Cancer (BCLC) staging system in the evaluation of all patients with HCC, which provides a comprehensive assessment of tumor burden, liver function, and performance status at the time of diagnosis. The panel also agreed that staging should include evaluation for pulmonary metastasis at the time of diagnosis.

Treatment

The panel believed that treatment recommendations should be based on BCLC staging documented in patients' records.[53,54] MLTB discussion of treatment options was deemed to be important, as was appropriate consideration of LT candidacy (in the absence of contraindications), albeit with variation in the scoring of gap.[5-7] Among patients with BCLC 0-A HCC without portal hypertension, the expert panel recommended that surgical resection should be considered in relevant cases. There was no agreement on criteria that would guide selection of any specific locoregional therapy in eligible candidates. There was broad support (importance and moderate presence of gap) for the use of systemic therapy in eligible patients. Experts included two process measures: (1) patients with cirrhosis with tumor progression after locoregional therapy who are not candidates for resection or LT should be offered systemic therapy and (2) patients with BCLC stage C, well-preserved liver function (Child-Pugh A), and

TABLE 1 Final set of quality measures in HCC care

Metrics	Importance	Gap
Surveillance		
Patients with cirrhosis should undergo surveillance for HCC with US of the liver every 6 months, with or without AFP	8	7
Patients with cirrhosis and cured hepatitis C infection should continue to undergo HCC surveillance	8	7
Regardless of cirrhosis status, Asian men infected with hepatitis B should undergo HCC surveillance beginning at age >40	8	7
Regardless of cirrhosis status, Asian women infected with hepatitis B should undergo HCC surveillance beginning at age >50	8	7
Regardless of cirrhosis status, patients with chronic hepatitis B who were born in sub-Saharan Africa should undergo HCC surveillance beginning at age 20	8	7
Regardless of cirrhosis status, adults infected with hepatitis B who have a family history of HCC should undergo HCC surveillance	8	7
Diagnosis		
Patients with underlying chronic liver disease and new AFP > 20 ng/ml should undergo diagnostic evaluation for HCC with dynamic CT or MRI	8	5
LI-RADS should be used by the interpreting radiologist to describe liver lesions found by dynamic CT or MRI in patients with cirrhosis or chronic hepatitis B	8	5
Among patients who undergo dynamic imaging to diagnose HCC, arterial phase enhancement and portal venous or delayed venous phase washout should be recorded	9	6
For patients who undergo tumor biopsy, pathological diagnosis of HCC should be based on the International Consensus Group for Hepatocellular Neoplasia recommendations using the required histological and immunohistological analyses	8	6
Patients with LI-RADS 3 lesions should undergo repeat dynamic imaging (with the same or different imaging modality) within 6 months[a]	8	5
Patients with LI-RADS 4 lesions should be reviewed by an MLTB[a]	8	5
Staging		
Patients with HCC should undergo cross-sectional imaging of the chest at the time of HCC diagnosis to evaluate for pulmonary metastases	8	5
Tumor burden, liver function, and performance status or score reflective thereof should be documented at the time of diagnosis of HCC	9	5
Treatment		
In patients with BCLC 0-A HCC without portal hypertension, surgical resection should be performed when anatomically possible	8	5
Patients with HCC without extrahepatic disease who are not resection candidates and without absolute contraindications for LT should undergo evaluation for LT	9	5
Patients with HCC should have LT candidacy documented in the medical record	8	7
Patients with HCC who are not candidates for resection, LT, or locoregional therapy should be offered systemic therapy	8	5
Patients with HCC that progresses after locoregional therapy and who are not candidates for resection or LT should be offered systemic therapy	8	5
Patients with well-preserved liver function (Child-Pugh A), good performance status, and BCLC stage C HCC should be offered systemic therapy	8	5
Patients with cirrhosis and BCLC stage D HCC who are not candidates for LT should receive palliative support	8	6
Advance care planning should be documented in patients with BCLC C or D HCC	8	6
Patients with HCC and symptomatic bone metastases should be offered palliative radiotherapy	8	5
MLTB recommendations should be documented in the medical record	9	6
Outcomes		
3-year survival	7	5
Percent of margin-negative resections	8	5
Percent clinical decompensation (ascites, hepatic encephalopathy, spontaneous bacterial peritonitis, jaundice, portal hypertension–related gastrointestinal bleed) within 30 days following locoregional therapy	7	6
Hospice, length of stay[a]	8	5
Intensive care unit utilization in the last 2 weeks of life[a]	8	5

Note: "Importance" was graded using a score ranging from 1 "not important at all" to 9 "extremely important." "Performance gap" was defined as the gap between optimal performance of each measure and current performance in clinical practice, with a score of 1 indicating "no gap" and a score of 9 indicating "the largest gap."

[a]Indicated measures introduced by expert panel and assigned a large gap >5 in practice by panel members.

TABLE 2 Patient rating of PROs in HCC using a modified Delphi process

	Number of patients	Standard deviation	This symptom/issue is very important to me (1 = not important, 5 = very important)	What are the top 3 most important symptoms to you?
Pain	74	1.30	3.66	51%
Uncertainty about the future	74	1.13	3.66	44%
Uncertainty about the best treatment for me	74	1.46	3.36	32%
Anxiety	74	1.30	3.22	26%
Strain on relationships with family and friends	72	1.58	2.96	22%
Fear	74	1.38	2.97	20%
Anxiety from waiting for my CT/MRI scan reports	74	1.37	2.8	16%
Depression	73	1.35	2.89	15%
Lack of information from medical team about my liver cancer	74	1.53	2.81	14%
Isolation	73	1.23	2.66	12%
Fear of treatments	74	1.43	3.03	12%
Lack of understanding why I have cancer	74	1.35	2.51	9%
Lack of understanding why I feel the way I feel	74	1.43	2.76	8%

Note: Patients with HCC across seven institutions ranked PROs derived from the scoping review. Symptoms were ranked on a Likert scale (1 = not important, 5 = very important). Patients were then asked to identify the three most important symptoms or issues. Symptoms are listed in descending order of priority (included in top three) among surveyed patients.

good performance status should be offered systemic therapy. Finally, there was broad support (importance and moderate presence of gap) for, when deemed appropriate, palliative care and advance care planning. In addition, palliative radiotherapy for symptomatic bone metastases was supported.

Clinical outcomes

Overall, 3-year survival was felt to be an appropriate outcome for patients with HCC. With regard to therapies, the percentage of margin-negative resections was recommended as an appropriate outcome measure for resection. The incidence of clinical decompensation within 30 days after locoregional therapy was deemed an important outcome measure. Two outcome measures addressed hospice length of stay and intensive care unit utilization within the last 2 weeks of life.

PROs

Seventy-four patients with HCC across seven institutions ranked PROs derived from the scoping review. Symptoms were ranked on a Likert scale (1 = not important, 5 = very important). We found that patients rated several outcomes as the most important symptoms or issues related to their HCC (Table 2). These included outcomes addressing pain, anxiety, fear of treatment, and uncertainty about the future as well as uncertainty about the best individual treatment. Pain, uncertainty about the future, and uncertainty about the best individual treatment were highlighted as the three most important symptoms or issues.

DISCUSSION

There is wide variation in care provided to patients with HCC across the spectrum of disease from surveillance to treatment.[26,29,55] Development of an explicit set of quality measures is the first step in improving the quality of care and bridging the gap between guidelines and measurable processes and outcomes. Previously, the AASLD PMC had identified quality measures for the care of patients with cirrhosis.[35] Herein, we describe the development of a set of 29 process and outcome measures that are important in the care of patients with HCC. These process measures span the spectrum of HCC care including surveillance, diagnosis, staging, and treatment. In addition to relevant clinical outcomes, we identified PROs through a formal scoping review as well as ranking by patients with HCC across several institutions and stages of liver cancer.

The final set of measures reflected emphasis on surveillance as well as diagnostic modalities with the hope of identifying HCC at an early stage. The large gap for a majority of these measures reflected the expert panel's concern that current standards of care recommended by various guidelines are not routinely followed. Treatment measures also support considering the entire spectrum of options from surgical resection and LT as well as appropriate use of systemic therapy. There was significant emphasis on consideration of

palliation with early advanced care planning, palliative radiotherapy for bone metastases, and appropriate referral to hospice.

Who will benefit from HCC practice metrics?

At a practicing physician or provider level, these measures serve as a practical tool or checklist for quality improvement interventions. Depending on the practice setting (primary care vs. specialty care) or specialty (hepatology, surgery, radiology, oncology, or palliative care), subsets of the measures can be applied and studied based on the populations served and the goals of care. At a system level, establishing a core set of measures facilitates improving the care provided to all patients with HCC across multiple interrelated disciplines as well as the continuum of disease severity. Finally, by accounting for PROs when evaluating the quality of care provided, congruency with the patient's aims and preferences can be evaluated. We anticipate that the proposed measures will lay the framework for better adherence to surveillance for HCC, improved early detection, and more appropriate application of curative therapies as well as early involvement of palliative care for appropriate patients.

Using PROs in an HCC practice

In a survey of 74 patients with HCC, we found that patients rated 4 outcomes as the most important symptom or issue related to their HCC. These included outcomes addressing pain, anxiety, fear of treatment, and uncertainty about the future as well as uncertainty about the best individual treatment. These PROs can be easily assessed at patient visits and addressed by providers. Addressing patients' preeminent concerns should improve patient satisfaction with care and may contribute to better adherence to recommended treatments or facilitate earlier meaningful goals of care discussions. Linking PROs to practice metrics along the continuum from early stage to advanced disease would further enhance the utility of these PROs in clinical practice.

Translating metrics into quality

The practice metrics selected from our process were judged to be important and to have a large gap in care for a representative cohort of patients with HCC. The ideal application of these practice metrics is in quality assurance and performance improvement efforts to improve care provided to patients with HCC. Selection of our measures was agnostic of capacity of electronic health records or other systematic approaches to data capture. Translating specific metrics into clinical measures requires work on defining the population, standardizing, and validating data collection and measurement and developing workflows that can incorporate both clinical as well as PROs. Accurate measurement will help establish baseline performance, allow for observation of change, and determine whether performance of measures is associated with improvement in outcomes. Over time, measures could be further refined with incorporation of actionable plan-do-study-act cycles.[56] Gaps in care delivery may be identified and will necessitate development of mechanisms or interventions to address these gaps. For example, electronic decision support may need to be built and mechanisms to provide seamless multidisciplinary care (synchronous or asynchronous) may need to be considered. Appropriate processes for linkage to care may need to be designed. Finally, evaluation of adherence to metrics will need a robust mechanism for data management as well as appropriate adjustment for the spectrum of patients with HCC who are seen. Unique collaborative efforts such as the Cirrhosis Quality Collaborative supported by the AASLD (https://www.aasld.org/programs-initiatives/cirrhosis-quality-collaborative), regional consortia focused on advancing HCC care (e.g., Texas Collaborative Center for Hepatocellular Cancer or translational liver cancer consortium), and larger national systems with inbuilt infrastructure (e.g., the Veterans Health Administration) may serve as initial testing grounds that span urban and rural centers of care.[57,58]

Contextual factors

Our collective work has several strengths. We systematically examined guidance offered by professional societies across relevant disciplines, included committee members with methodologic expertise in health care delivery research, and involved a multidisciplinary expert panel with clinical and content expertise in the realm of HCC care. We employed a modified Delphi process to obtain consensus on importance of measures as previously done.[45] There are, however, notable limitations to the development of these HCC practice metrics. Practice measures do not address issues of access to care, socioeconomic or insurance status, or regional variation by race and ethnicity. In addition, measures may be more easily implemented at tertiary practices and larger health care systems with ample resources.[59,60] In addition, certain measures may not apply to all programs (e.g., access to LT) but may support improved linkage to nontransplant care given available resources. Although we report expert panel perception of gaps for individual metrics, we were not able to assess the relative weight

of each measure and its impact on improving HCC care. For example, the relative contribution of early detection through surveillance may be different than early referral to LT. PROs were reviewed by unselected patients with HCC; certain PROs may only be applicable to smaller subsets of patients with HCC. For example, pain control may be highly important in those with larger tumor burden. Future investigations should examine application of PRO by stage of HCC, type of treatment, and disease severity and also take into account variation by access to care and relevant demographics. Several other measures were excluded due to variation or lower rate of agreement as well as lower perceived gaps in care or applicability to only a limited subset of patients. We also acknowledge that not all measures may be able to be implemented as intended. However, the stepwise efforts in recent collaborative endeavors (e.g., Cirrhosis Quality Collaborative) may offer a template to future incremental adoption.

Limitations of implementation

Although these measures offer guidance over the entire spectrum of HCC care, centers may choose to focus on measures that are more feasible or those that can be easily implemented and measured. Structured data collection can be challenging but will be facilitated by greater use of electronic medical records and common platforms. Although data collection gaps will be identified, this may prompt the development of minimum reporting standards by specialty. Appropriate analysis of data will also be important, specifically ensuring adjustment of performance for specific diagnostic, therapeutic, and outcomes metrics for different stages of HCC as well as case mix before implementation. Reliance on diagnostic coding and retrieval of administrative data may need to be supplemented by manual chart review to ensure collection of valid outcomes.

In summary, the AASLD PMC has developed a set of explicit quality measures for patients at risk of and with HCC as the first step in improving the quality of care of patients with HCC, bridging the gap between guidelines and recommendations and measurable processes and outcomes. Employing a formal scoping process as well as ranking by patients with HCC, we identified PROs that could be used to improve the quality and delivery of and satisfaction with care. These measures require testing and validation in diverse, real-world practice settings. Implementation of these metrics could be a central step in the improvement of patient care and outcomes in this high-risk population.

CONFLICT OF INTEREST

Dr. Merriman received grants from Intercept. Dr. Morgan received grants from Genfit, Gilead, and AbbVie. Dr. Parikh consults for and received grants from Exact Sciences. He advises and received grants from Genentech and Bayer. He consults for Bristol Myers Squibb, Eli Lilly, and Freenome. He advises Eisai, Exelixis, and Wako/Fujifilm. He received grants from Target RWE and Glycotest. Dr. Kanwal received grants from Gilead and Merck. Dr. Volk consults for Boston Scientific. Dr. Serper consults for Gilead. Dr. Chernyak consults for Bayer. Dr. Singal consults for Genentech, Bayer, Eisai, AstraZeneca, Exelixis, Bristol Myers Squibb, Roche, Exact Sciences, Glycotest, and Fujifilm. Dr. Salem consults for and received grants from Boston Scientific. He consults for Bard, Sirtex, Genentech, Eisai, AstraZeneca, and Roche.

AUTHOR CONTRIBUTIONS

Authors had access to all the study data, take responsibility for the accuracy of the analysis, and had authority over manuscript preparation and the decision to submit the manuscript for publication. All authors approve the manuscript.

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SUPPORTING INFORMATION

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