

# UCSF

## UC San Francisco Previously Published Works

### Title

Unifying the Hepatopancreatobiliary Surgery Fellowship Curriculum via Delphi Consensus.

### Permalink

<https://escholarship.org/uc/item/62g2p7pz>

### Journal

Journal of the American College of Surgeons, 233(3)

### ISSN

1072-7515

### Authors

Park, Keon Min  
Rashidian, Nikdokht  
Mohamedaly, Sarah  
[et al.](#)

### Publication Date

2021-09-01

### DOI

10.1016/j.jamcollsurg.2021.06.004

Peer reviewed



# HHS Public Access

Author manuscript

*J Am Coll Surg.* Author manuscript; available in PMC 2022 September 01.

Published in final edited form as:

*J Am Coll Surg.* 2021 September ; 233(3): 395–414. doi:10.1016/j.jamcollsurg.2021.06.004.

## Unifying the Hepatopancreatobiliary Surgery Fellowship Curriculum via Delphi Consensus

**Keon Min Park, MD,**

Division of Plastic Surgery, Department of Surgery, University of California San Francisco, San Francisco, CA

**Nikdokht Rashidian, MD, FEBS,**

Department of Human Structure and Repair, Ghent University, Ghent, Belgium

**Sarah Mohamedaly, MD,**

Department of Surgery, University of California San Francisco, San Francisco, CA

**Karen J Brasel, MD, MPH, FACS,**

Oregon Health Sciences University, Portland, OR

**Patricia Conroy, MD,**

Department of Surgery, University of California San Francisco, San Francisco, CA

**Alexa C Glencer, MD,**

Department of Surgery, University of California San Francisco, San Francisco, CA

**Jin He, MD, PhD, FACS,**

Johns Hopkins University School of Medicine, Baltimore, MD

**Michael J Passeri, MD,**

Division of HPB Surgery, Department of Surgery, Carolinas Medical Center, Charlotte, NC

**Nitin N Katariya, MD, FACS,**

Division of Transplant, Department of General Surgery, Feinberg School of Medicine, Northwestern University, Chicago, IL

**Adnan Alseidi, MD, EdM, FACS,**

**TrainHPB research group**

Department of Surgery, University of California San Francisco, San Francisco, CA

### Abstract

Correspondence address: Keon Min Park, MD, Division of Plastic Surgery, Department of Surgery, University of California, San Francisco, CA. keon.park@ucsf.edu.

Drs Park and Rashidian contributed equally to this manuscript.

Author Contributions

Study conception and design: Park, Rashidian, Mohamedaly, Brasel, Conroy, Glencer, He, Passeri, Katariya, Alseidi

Acquisition of data: Park, Rashidian, Mohamedaly, Brasel, Conroy, Glencer, He, Passeri, Katariya, Alseidi

Analysis and interpretation of data: Park, Rashidian, Mohamedaly, Brasel, Conroy, Glencer, He, Passeri, Katariya, Alseidi

Drafting of manuscript: Park, Rashidian, Mohamedaly, Brasel, Conroy, Glencer, He, Passeri, Katariya, Alseidi

Critical revision: Park, Rashidian, Mohamedaly, Brasel, Conroy, Glencer, He, Passeri, Katariya, Alseidi

Disclosure Information: Nothing to disclose.

TrainHPB research group members are listed in the Appendix.

**BACKGROUND:** Hepatopancreatobiliary (HPB) Fellowship training in the Americas consists of 3 distinctive routes with variable curricula: Surgical Oncology Fellowship via the Society of Surgical Oncology (SSO), Abdominal Transplant Surgery Fellowship via the American Society of Transplant Surgeons (ASTS), and HPB Fellowship via the Americas Hepato-Pancreato-Biliary Association (AHPBA). Our objective was to establish a pan-American consensus among HPB surgeons, surgical oncologists, abdominal transplant surgeons, and general surgery residency program directors (GSPDs) on a core knowledge curriculum for HPB fellowship, and to identify topics appropriate for general surgery residency and subspecialty beyond HPB fellowship.

**STUDY DESIGN:** A 3-round modified Delphi process was used. Baseline statements were developed by the Education and Training Committee of the AHPBA, in collaboration with representatives of the SSO, ASTS, and GSPDs. The expert panel, consisting of members of the 3 societies together with GSPDs, rated the statements on a 5-point Likert scale and suggested editing or adding new statements. A statement was included in the final curriculum when Cronbach's alpha value was  $\geq 0.8$  and  $\geq 80\%$  of the panel agreed on inclusion.

**RESULTS:** The response rate was 100% for the first round, and 98% for the second and third rounds. Eighty-nine of 138 proposed statements were included in the final HPB fellowship curriculum. Curricula for general surgery residency and subspecialty beyond HPB fellowship included 50 and 29 statements, respectively.

**CONCLUSIONS:** A multinational consensus on core knowledge for an HPB fellowship curriculum was achieved via the modified Delphi method. This core curriculum may be used to standardize HPB fellowship training across different pathways in the Americas.

Hepatopancreatobiliary (HPB) surgery is a technically complex subspecialty for which various training pathways result in different practice patterns. Although additional training beyond general surgery residency is a uniformly agreed upon requirement for HPB practice, there are multiple options for fellowship training in HPB surgery. Currently, advanced HPB surgical training in the Americas is offered through 3 distinct tracks: Surgical Oncology Fellowship (Society of Surgical Oncology, SSO), Abdominal Transplant Surgery Fellowship (American Society of Transplant Surgeons, ASTS), and Hepato-Pancreato-Biliary Fellowship (Americas Hepato-Pancreato-Biliary Association, AHPBA). Each of these programs offers unique training curricula, which result in variable graduate knowledge and experiences in index operations. Although this diverse training supports the development of a more flexible surgical workforce, it is crucial to ensure that graduating trainees are adequately and uniformly prepared for successful and safe practice.

Although the perceived deficits in training vary among graduates from different fellowships, there is a clear desire among leaders in the SSO, ASTS, and AHPBA to establish appropriately robust and transparent metrics for graduating fellows across all HPB training pathways.<sup>1</sup> The development of minimum common standards for HPB surgical training across fellowships would ideally decrease the currently observed variability in training. Further collaboration is critical to facilitate the consistent training of qualified HPB surgeons.

The Delphi method has been used to achieve consensus among experts in various areas of surgical education.<sup>2,3</sup> Recently, a 3-round, modified Delphi technique was used to determine

key components of a hepatobiliary surgery curriculum for general surgery residents.<sup>2</sup> Delphi consensus methodology is a process in which a research question is answered by gathering expert opinions in a blinded, structured, and interactive manner through multiple rounds to reach collective agreement.<sup>4</sup> The premise is to enhance individual independent judgment through collective intelligence. In most cases, 2 to 3 rounds of expert surveys are sufficient to reach a consensus.<sup>5</sup>

In this study, we aimed to establish a national consensus among HPB surgeons, surgical oncologists, abdominal transplant surgeons, HPB fellows, and attending surgeons serving as general surgery residency program directors (GSPDs) on a knowledge curriculum for HPB fellowship using the modified Delphi method. Our goal was to identify the core components that should serve as a standardized base curriculum across all HPB fellowship training pathways in the Americas. This curriculum could then be divided into modules for easy application across the various fellowship pathways. Our goal is for this new curriculum to reflect the daily practice of HPB surgeons, thereby ensuring quality and consistency in their training.

## METHODS

### Study design

This study was approved by the Institutional Review Board at the University of California, San Francisco (IRB study number 20-31912). The Delphi methodology was employed using online surveys, with the aim of reaching consensus on a core knowledge curriculum for HPB fellowship training.

In the conventional Delphi method, first-round statements are defined by the expert panel. In this study, however, we used the modified Delphi technique by developing baseline statements by merging and adopting the learning objectives of the HPB Surgery Curriculum for HPB Surgery Fellowship (provided by the Fellowship Council and the AHPBA), the Surgical Oncology Fellowship Curriculum (based on the Surgical Council on Resident Education [SCORE] General Surgery Curriculum), and the National Transplant Curriculum (provided by ASTS) (Fig.1).<sup>6-9</sup> To carry out this process, the Education and Training Committee of AHPBA formed a taskforce consisting of AHPBA members with diverse background to include 1 SSO program faculty, 1 ASTS program faculty, 1 AHPBA fellowship faculty, and 1 recent fellow. Also, 1 GSPD with extensive experience in developing entrusted professional activities, and 2 surgical education researchers were included in the taskforce. The members of this taskforce did not participate in the Delphi rounds.

The learning objectives were divided into 7 domains: Liver, Gallbladder, and Biliary System; Pancreas, Duodenum, and Spleen; Transplantation; Imaging; Oncology; Trauma; and Cognitive Elements of Psychomotor Tasks.

### Expert panel recruitment

Similar numbers of expert attending surgeons from SSO, ASTS, and AHPBA, were selected via purposive sampling based on their wealth of experience in HPB and transplant surgery,

as well as their contributions to fellowship training demonstrated by their current or past status of fellowship program director or assistant program director. All invited surgeons had to be actively working as faculty in 1 of the 3 fellowship programs, and preferably be active in education of fellows. The aim was to have a diverse group in terms of region (from Canada, Mexico, and the US), sex, setting of practice (academic, private medical centers), and to include both junior and senior attendings. For validation purposes, GSPDs and current surgical oncology, abdominal transplant, and HPB fellows were also invited to participate. The GSPDs were selected among those who are involved in the national entrusted professional activities with respect to curricula redesign. Participation in the study was voluntary, and the identity of the participants remained anonymized.

There is no consensus on Delphi panel size. However, a minimum of 10 panelists for homogeneous groups and 30 panelists for heterogeneous groups have been recommended.<sup>10-12</sup> Consequently, we aimed to recruit a diverse panel of 50 surgeons (10 panelists from each group) as described above.

### **Definition of consensus**

A previous consensus was defined when the following 2 conditions were met after a minimum of 3 Delphi rounds: Cronbach's alpha value of greater than 0.8 and percentage of panel agreement: 80% or more of panelists agree or strongly agree on each statement. These are reliable indicators of consensus frequently used in previous Delphi studies.<sup>13-16</sup>

### **Delphi survey rounds**

The surveys for each Delphi round were distributed via an online questionnaire (Qualtrics). For each round of surveys, the panel was given 2 weeks to respond. Nonresponders received additional reminders and were allowed up to 4 weeks to respond. The questionnaires were prospectively validated to prevent missing data.

The first survey included 138 statements. Participants were asked to choose if the statements represented appropriate learning objectives for residency, fellowship, or further sub-specialized training beyond the fellowship level. Boxes for free text were included in the survey to encourage any comments or suggestions for editing the statements and/or proposing additional items. After each round, the percentages of agreement were collected and reported to participants anonymously in the next round.

After the first round, statements that had 80% or greater consensus as "appropriate at the residency level" were excluded from the second-round survey and included in the residency curriculum. The remaining statements were then modified, and additional statements were added based on the comments received during the first round. For the second round, the panelists were asked to rate their degree of agreement on whether each curriculum statement should be included in the HPB fellowship curriculum on a 5-point Likert scale (strongly disagree [1] to strongly agree [5]). Statements with 80% agreement (somewhat agree [4] and strongly agree [5]) were included in the proposed fellowship curriculum for the third-round survey. Statements that had 70% to 80% agreement within the entire panel, but which had statistically significant disagreement from GSPDs, were considered appropriate for both curricula for general surgery residency and HPB fellowship. Statements with <70%

agreement were either included in the residency curriculum or considered to be appropriate for further subspecialized training beyond fellowship based on the comments received from the panel.

The third and final round of the survey comprised the proposed curriculum based on the results of the first and second rounds. The panelists were asked to indicate whether they agreed or disagreed that the entire group of curriculum statements under each of the 7 domains was appropriate for HPB fellowship training.

### Statistical analysis

Cronbach's alpha was used to determine internal consistency in the first and second rounds. A Cronbach's alpha value  $>0.7$  is indicative of an acceptable level of reliability, while a value  $>0.9$  is considered to represent excellent reliability.<sup>17</sup>

Data were analyzed using nonparametric tests. The Kruskal-Wallis test was used to determine rating differences among the 5 subgroups of panelists (AHPBA surgeons, SSO surgeons, ASTS surgeons, GSPDs, and surgical fellows). Levene's test was used to evaluate whether the homogeneity distribution of variance in each group was the same. The Bonferroni significant difference test was used post-hoc when the groups were determined to be homogeneous by Levene's test, whereas the Games-Howell test was used when the groups were heterogeneous. The Wilcoxon rank-sum test was used to compare 1 group to cumulative data from all 4 other groups. A 2-sided alpha of 0.05 was used to determine statistical significance for all analyses. Data analysis was performed using SPSS version 27 (IBM).

## RESULTS

### Panel

Out of a total of 60 invitations (12 surgeons from each group), 49 (82%) agreed to participate in this study, of which 41 were attending surgeons and 8 were fellows (Table 1). The study was performed from August 2020 to February 2021.

### First-round survey

The response rate was 100% for the first round with excellent internal consistency (Cronbach's alpha = 0.98). Of the 138 statements in the first round, 33 were deemed appropriate for residency curriculum and were excluded. Fourteen statements were modified, 2 were merged to avoid redundancy, and 18 new items were added to the second-round survey, resulting in a total of 122 statements for the second Delphi round (Fig. 1).

### Second-round survey

All participants who completed the first round were invited to participate in the second. Forty of the 41 attending surgeons (98%) and all fellows (100%,  $n = 8$ ) completed the second round survey with excellent internal consistency (Cronbach's alpha = 0.98). Of the 122 statements in the second survey, 34 were excluded and 1 new statement was added, resulting in a total of 89 statements in the third-round survey (Table 2). The excluded

statements were added to either general surgery residency or subspecialty curriculum. After the first 2 rounds, 50 statements were determined to be appropriate for general surgery residency (Table 3), and 29 for further subspecialized interests beyond HPB fellowship (Table 4). Eleven statements were included in both the general surgery residency and HPB fellowship curricula because both GSPDs and fellowship experts felt the topics should be covered (Tables 2, 3).

The majority of statements chosen for the third-round survey received homogeneous responses from the 5 panelist subgroups (AHPBA surgeons, SSO surgeons, ASTS surgeons, GSPDs, and surgical fellows) (88%, n = 79/89). Of the 10 statements with heterogeneous responses, only 1, “Bile duct injury (advanced considerations): Role for transplant after bile duct injury,” was answered differently between the groups. However, this statement still achieved consensus, as the variation was only whether the respondent agreed “somewhat” or “strongly.”

Of the 5 subgroups, responses from GSPDs differed the most. However, their responses were significantly different from all others for only a minority of statements (33%, n = 29/89). There were no significant differences in the survey responses from surgical fellows.

### Third-round survey

All participants (n = 49) who completed the first round were invited to participate in the third. Forty of 41 attending surgeons (98%) and all fellows (100%, n = 8) completed the survey. Agreement was excellent. The majority of domains were in the 100<sup>th</sup> percentile, with the exception of Transplantation (94<sup>th</sup> percentile) and Imaging (98<sup>th</sup> percentile) (Fig. 2).

## DISCUSSION

Using Delphi consensus methodology with a panel of nationally recognized HPB experts, we identified components of a core knowledge curriculum that could be used to create a framework for the standardization of advanced HPB training. While the primary objective was to achieve consensus among experts in HPB surgery, we included GSPDs and HPB fellows because we expected their insight would be equally valuable. Given that we were able to identify a number of statements more appropriate for general surgery residency than for HPB fellowship, perspectives of GSPDs were immensely beneficial.

Overall, there was excellent internal consistency in each round of review, indicating a high level of consensus on the fundamental components of an advanced HPB fellowship curriculum. Although each fellowship program offers valuable distinctive features in training, this framework outlines the essential knowledge skillset for advanced HPB surgical practice. Such standardized curricula have been associated with improved patient outcomes and decreased complication rates.<sup>18-20</sup> Given the complexity of HPB pathology and its surgical management, a standardized curriculum of advanced training in the various fellowship programs that provide HPB training is imperative to produce adequately trained surgeons.



Internal consensus across 7 diverse domains was excellent (Cronbach's alpha = 0.98) in the first and second rounds of surveys among participants from all 5 participating groups. Given the heterogeneity of the survey respondents, who represented fellowship directors from 3 societies as well as GSPDs and fellows, a consensus of 80% in selecting statements for the third round of surveys was also considered to meet a high threshold.

The excellent agreement between fellows and fellowship directors, without significant differences, indicated that both trainees and mentors shared similar viewpoints on the curriculum and reflected its strength. When there were significant differences in the opinions of GSPDs and fellowship directors (in response to 33% of statements selected for the third round), we considered the item to be appropriate for both general surgery residency and HPB fellowship curricula. By doing so, we sought to address the perceived deficit of HPB training at the residency level as well as concerns among GSPDs regarding the negative effects of sub-specialization on general surgery training.

There is growing concern that residents who do not choose to pursue fellowship may be unprepared for general practice.<sup>19,20</sup> Furthermore, this discrepancy between what GSPDs and HPB attendings consider appropriate for general surgery residency may partially explain why some fellows are thought to be inadequately prepared for fellowship.<sup>21,22</sup> The opinions of GSPDs on the subject provided invaluable insights. Whether these topics are covered in general surgery residency or not, ensuring qualified HPB surgeons remains the responsibility of the fellowship program.

Although there was high consensus overall in the Liver, Gallbladder, and Biliary System domain (with 32 statements achieving 81% to 100% consensus), 2 topics relating to gallbladder disease and subtotal cholecystectomy had lower consensus (75% to 77%) and, as such, were included in both curricula. Of the 16 consensus statements in the Pancreas, Duodenum, and Spleen domain, only 1 achieved < 80% consensus. Whereas 86% of HPB attendings thought understanding the indications for interventional radiology (IR) management of chronic pancreatitis was appropriate for the fellowship level, only 63% of GSPDs agreed. Although patients with chronic pancreatitis are often attended by general surgery residents via supportive or IR management, surgical management of chronic pancreatitis is more appropriate for fellowship training.<sup>23,24</sup> Therefore, the low consensus may have stemmed from the difference between surgical and IR management.

The technical aspects of liver transplantation were thought to be appropriate at the fellowship level, whereas the management of pre-liver transplant patients was included in both curricula. GSPDs believed management of patients listed for transplant should be covered at the residency level because patients awaiting liver transplantation are often managed at rural hospitals without HPB subspecialty access.<sup>25</sup> Several statements within the transplant domain were considered to be beyond the scope of a typical HPB fellowship and were, instead, thought to be better suited for advanced abdominal transplantation training. These statements included advanced vascular and biliary reconstruction at the time of transplant, organ procurement from brain-dead and donation-after-cardiac-death donors, and pediatric liver transplant. Abdominal transplantation fellowship programs accredited through the ASTS in the US and Canada incorporate this highly specialized training, and it is clear



that transplantation training will continue to incorporate objectives beyond a standardized HPB fellowship curriculum.

Within the trauma/bile duct injury domain, there was unanimous consensus on the importance of “advanced considerations for bile duct injuries.” However, the management of liver and pancreatic trauma had lower consensus. GSPD and fellowship directors disagreed about whether advanced technical considerations for liver trauma—such as selective vessel ligation, vascular exclusion, and the use of advanced hemostatic agents—should be included in general surgery residency training or HPB-focused fellowship training. Similarly, there was disagreement as to whether principles of management of pancreatic trauma should be a standard component of general surgery training or reserved for fellowship training. These statements were included in the curricula of both tracts. The lack of consensus may have originated from the fact that traumatic management of liver and biliary system is often considered to be a responsibility of Acute Care Surgery fellowship. While this is true, HPB surgeons are required to learn some basic concepts of how to manage liver and bile duct trauma.

There was less discrepancy among the responses for the other domains. Specifically, the ability to lead a multidisciplinary tumor board conference was suggested as a new statement after the second-round survey by several panelists, and its importance was confirmed in the third round. This correlates with a previous finding in which surveyed fellowship directors expressed a desire for stronger patient ownership demonstrated by fellows.<sup>15</sup> Within the Imaging domain, the panelists agreed that a basic understanding of imaging modalities was appropriate in residency. In contrast, indications for various intraoperative imaging modalities and their technical considerations were felt to be more appropriate at the fellowship level. Within the Oncology domain, the panel agreed that the appropriate management of cancer patients includes end-of-life and palliative care. Finally, within the Psychomotor domain, the importance of mastering global care for patients was again emphasized: technical mastery, anesthetic considerations, and operative set-up were all deemed important in fellowship.

We acknowledge that some topics we included in the core HPB fellowship curriculum may be taught in general surgery residency programs when HPB surgeons are involved in training residents. This is beneficial for general surgery residents, especially for those who are not pursuing HPB fellowships. Our goal is not to deter this practice but rather, to recognize the variability of general surgery residency training and to ensure that every fellow in HPB fellowship programs is proficient in every topic in the core curriculum.

This study is limited by the nature of the Delphi methodology, which has the potential to introduce selection bias.<sup>26</sup> We attempted to minimize this risk by selecting a similar number of panelists from all 3 societies and GSPDs from diverse practice settings, and by recruiting more panelists comparing to previous studies with heterogeneous panel<sup>10-12</sup> For those topics in which fellowship directors and GSPDs disagreed over the respective responsibility of residency or fellowship training, we resolved this issue by including them in both curricula.

Our study is relevant for other surgical specialties as well because the same methodology can be used across all surgical disciplines, not only to establish a core curriculum but also to review and update existing curricula in order to stay up-to-date by gathering expert opinions.

### Future directions

The next step is to implement the core curriculum effectively. In order to do so, first, we need to identify the best modality of teaching based on the content and complexity of each curriculum topic. A subcommittee under the Education and Training Committee of AHPBA already has begun to tackle this process by conducting a stepwise study for each curriculum topic. Both in-person and virtual tools such as live talks, webinars, North American HPB grand rounds, and myHPB, provided by International Hepato-Pancreato-Biliary Association (IHPBA), are being considered.<sup>27,28</sup> Some of the contents will be maintained as local responsibility.

Once the ideal modality is decided, we need to find appropriate resources and share them via a central website for the educators and the fellows. The website will share a list of available visiting speakers or links to virtual resources under each topic. The resources should be marked for appropriate time for review and update to ensure that the information stay current and relevant.

Each fellowship can use modular training based on the core curriculum as well in order to fill in gaps for trainees and capitalize on the expertise of individual programs. In fact, some programs already do this; surgical oncology fellows at MD Anderson Cancer Center (Houston, TX) rotate at Houston Methodist Hospital (Houston, TX) to broaden their abdominal transplantation experience, whereas general surgery residents at Houston Methodist Hospital rotate at MD Anderson Cancer Center to enhance their surgical oncology experience. This tactic will not only benefit the programs by preventing replication of work, but will also enable all fellows from 3 different tracts of HPB fellowship programs to reach a better baseline and cover all the curriculum.

Lastly, the core curriculum can be used for assessments in the future. The current HPB curriculum has a greater degree of freedom since there is no certifying board examination to become an HPB surgeon. However, implementation of a standardized core curriculum can be the first step in unifying requirements for the field. Then, appropriate assessments or examinations based on the core curriculum should be developed not only to evaluate the trainees, but also to validate the core curriculum and success of its implementation.

## CONCLUSIONS

We have developed a core curriculum for HPB fellowship training using the Delphi consensus methodology. In addition to underlining the core topics needed for fellowship-level training, we identified topics that should be added to general surgery residency training, expanding the current HPB curriculum for residents. We also identified topics that may be beyond the scope of general HPB fellowship, highlighting areas in which each individual fellowship can provide unique expertise for its trainees. Implementation of this

curriculum could bridge the gaps in core knowledge differences that stem from different fellowship tracks.

### Acknowledgement:

This document was reviewed and endorsed by AHPBA. The Education and Training Committee of AHPBA will be entrusted to follow up on further steps. The authors thank Pamela Derish in the UCSF Department of Surgery Publications Core for editorial assistance.

### APPENDIX

Members of the TrainHPB Research Group: Cary B Aarons, MD, FACS (Division of Colorectal Surgery, Department of Surgery, University of Pennsylvania, Philadelphia, PA), Mohammad Al Efishat, MD (Department of Surgery, Johns Hopkins University School of Medicine, Baltimore, MD), Erin Baker, MD (Division of Hepatobiliary Surgery, Department of Surgery, Carolinas Medical Center, Atrium Health, Charlotte, NC), Christina Bailey, MD (Department of Surgery, Division of Surgical Oncology, Vanderbilt University Medical Center, Nashville, TN), Meredith Barrett, MD (Department of General Surgery, University of Michigan, Ann Arbor, Michigan), John R Bergquist, MD (Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, Stanford University, Stanford, CA), Prosanto Chaudhury, MD (McGill University Health Centre, Department of Surgery, Montreal, Canada), Lily Chang, MD, FACS (Department of General, Thoracic, and Vascular Surgery, Virginia Mason Medical Center, Seattle, Washington), Thomas E Clancy, MD, FACS (Division of Surgical Oncology, Department of Surgery, Harvard Medical School, Brigham and Women's Hospital, Boston, MA), Sean P Cleary, MD, FACS (Division of Hepatobiliary and Pancreatic Surgery, Mayo Clinic College of Medicine and Science, Rochester, MN), Sandra DiBrito, MD, PhD (Department of Surgical Oncology, University of Texas MD Anderson Cancer Center, Houston, TX), Mary Dillhoff, MD, FACS (Division of Surgical Oncology, Department of Surgery, Ohio State University Wexner Medical Center, Columbus, OH), Ismael Dominguez-Rosado, MD, FACS (Department of Surgery, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico), Majella Doyle, MD (Department of Abdominal Organ Transplantation Surgery, Washington University School of Medicine, St Louis, MO), Monica Dua, MD, FACS (Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, Stanford University, Stanford, CA), Wendy J Grant, MD, FACS (Division of Transplant, Department of Surgery, University of Nebraska Medical Center, Omaha, NE), Sunil K Geevarghese, MD, FACS (Department of Surgery, Division of Hepatobiliary Surgery and Liver Transplantation, Vanderbilt University Medical Center, Nashville, TN), Jake A Greenberg, MD, EdM, FACS (Department of Surgery, Medical College of Georgia, Augusta University, Augusta, GA), Ganesh Gunasekaran, MD, FACS (Recanati-Miller Transplantation Institute, Icahn School of Medicine at Mount Sinai, New York, NY), W Scott Helton, MD, FACS (Section of General, Thoracic, and Vascular Surgery, Department of Surgery, Virginia Mason Medical Center, Seattle, WA), Benjamin T Jarman, MD, FACS (Department of General Surgery, Gundersen Health System, La Crosse, WI), Dhires Rohan Jeyarajah, MD, FACS (Department of Hepatopancreaticobiliary Surgery, Methodist Richardson Medical Center, Richardson, TX), Amit R T Joshi, MD, FACS (Department of Surgery, Einstein Healthcare Network, Philadelphia, PA), Elizabeth A King, MD (Department of Surgery, Johns Hopkins University

School of Medicine, Baltimore, MD), Russell Kirks, MD (Division of Pancreas, Liver, and Biliary Surgery, Virginia Mason Medical Center, Virginia Mason HPB Surgery, Seattle, WA), Jennifer LaFemina, MD, FACS (Department of Surgery, University of Massachusetts Medical School; Worcester, MA), Lily L Lai, MD, FACS (Department of Surgery, City of Hope National Medical Center, Duarte, CA), Robert CG Martin II, MD, FACS (Department of Surgery, University of Louisville, Louisville, KY), John B Martinie, MD, FACS (Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, Atrium Health Carolinas Medical Center, Charlotte, NC), Amit K Mathur, MD, FACS (Department of Surgery, Division of Transplantation, Mayo Clinic, Phoenix, AZ), Laleh G Melstrom, MD, FACS (Department of Surgery, City of Hope National Medical Center, Duarte, CA), Michael O Meyers, MD, FACS (Division of Surgical Oncology and Endocrine Surgery, Department of Surgery, University of North Carolina, Chapel Hill, NC), Stephanie L Nitzschke, MD, FACS (Division of Trauma, Burns, and Surgical Critical Care, Brigham and Women's Hospital, Boston, MA), Susan L Orloff, MD, FACS (Department of Surgery, Division of Abdominal Organ Transplantation/Hepatobiliary Surgery, OHSU, Portland, OR), Ron Pery, MD (Department of Surgery, Mayo Clinic College of Medicine, Rochester, MN), Marcos E Pozo, MD (Department of Surgery, Northwestern Memorial Hospital, Northwestern University Feinberg School of Medicine, Chicago, IL), Edgardo S Salcedo, MD, FACS (Department of Surgery, University of California Davis, Sacramento, CA), George A Sarosi Jr, MD, FACS (Department of Surgery, University of Florida Health, 1600 SW Archer Ave, PO Box 100109, Gainesville, FL), Kevin C Soares, MD (Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, NY), Christopher J Sonnenday, MD, MHS, FACS (Department of Surgery, Section of Transplantation, University of Michigan, Ann Arbor, MI), Shareef Syed, MD, FACS (Department of Surgery, University of California San Francisco, San Francisco, CA), Tsuyoshi Todo, MD, FACS (Department of Surgery, Cedars-Sinai Medical Center, Los Angeles, CA), Susan Tsai, MD, FACS (Division of Surgical Oncology, Medical College of Wisconsin, Milwaukee, WI), Ching-Wei D Tzeng, MD, FACS (Department of Surgical Oncology, University of Texas MD Anderson Cancer Center, Houston, TX), Brendan C Visser, MD, FACS (Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, Stanford University, Stanford, CA), Susanne G Warner, MD, FACS (Department of Surgery, City of Hope National Medical Center, Duarte, CA), Steven A Wisel, MD (Division of Transplantation, Department of Surgery, University of California San Francisco, San Francisco, CA), Sabino Zani Jr, MD (Division of Surgical Oncology, Department of Surgery, Duke University Medical Center, Durham, NC), Nicholas J Zyromski, MD, FACS (Department of Surgery, Indiana University School of Medicine, Indianapolis, IN)

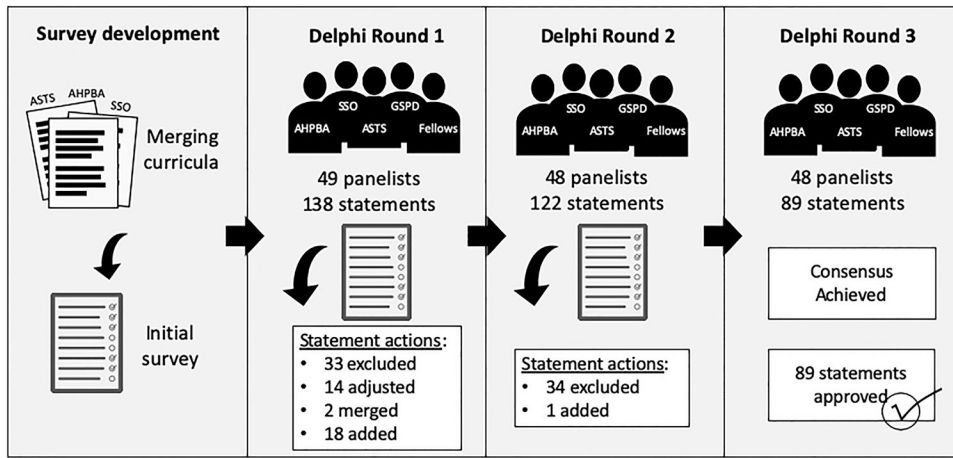
## Abbreviations and Acronyms

<b>AHPBA</b>	Americas Hepato-Pancreato-Biliary Association
<b>ASTA</b>	American Society of Transplant Surgeons
<b>GSPD</b>	general surgery residency program directors
<b>HPB</b>	hepatobiliary

## REFERENCES

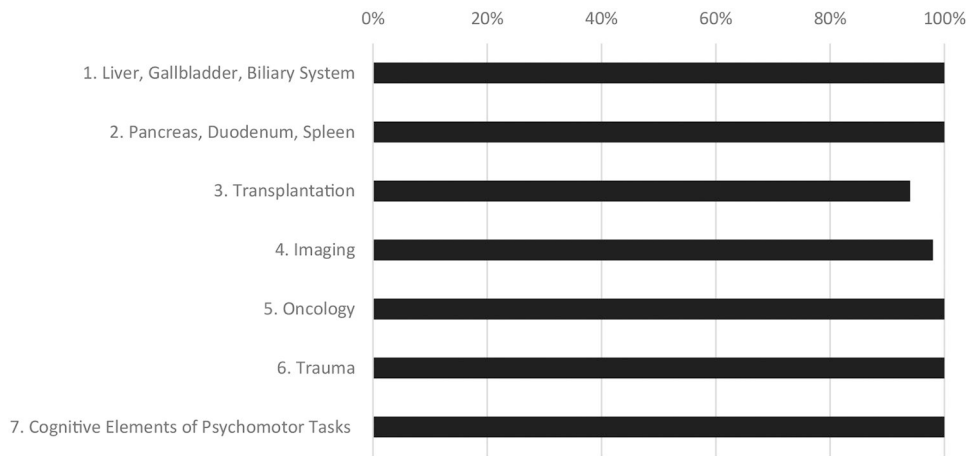
1. Warner SG, Alseidi AA, Hong J, et al. What to expect when you're expecting a hepatopancreatobiliary surgeon: self-reported experiences of HPB surgeons from different training pathways. *HPB (Oxford)* 2015;17:785–790. [PubMed: 26222978]
2. Rashidian N, Willaert W, Van Herzele I, et al. Key components of a hepatobiliary surgery curriculum for general surgery residents: results of the FULCRUM International Delphi consensus. *HPB (Oxford)* 2020;22:1429–1441. [PubMed: 32060009]
3. Deal SB, Alseidi AA, Chipman JG, et al. Identifying priorities for faculty development in general surgery using the Delphi Consensus Method. *J Surg Educ* 2018;75:1504–1512. [PubMed: 30115566]
4. Dalkey NC. *The Delphi Method: An experimental study of group opinion*. Santa Monica, CA: Rand Corporation; 1969.
5. Niederberger M, Spranger J. Delphi Technique in health sciences: A map. *Front Public Health* 2020;8:457. [PubMed: 33072683]
6. Rashidian N, Vierstraete M, Alseidi A, et al. Surgical education interventions in liver surgery: a systematic review. *Updates Surg* 2020;72:583–594. [PubMed: 32342345]
7. Education & Training | AHPBA. Available at: <https://www.ahpba.org/education-training/>. Accessed March 7, 2021.
8. SCORE | Curriculum Outline. Available at: <https://www.surgicalcore.org/public/curriculum#cgso>. Accessed March 7, 2021.
9. ASTS Learning: National Transplant Curriculum. Available at: <https://learn.asts.org/national-transplant-curriculum>. Accessed March 7, 2021.
10. de Villiers MR, de Villiers PJT, Kent AP. The Delphi technique in health sciences education research. *Med Teach* 2005;27:639–643. [PubMed: 16332558]
11. Akins RB, Tolson H, Cole BR. Stability of response characteristics of a Delphi panel: application of bootstrap data expansion. *BMC Med Res Methodol* 2005;5:37. [PubMed: 16321161]
12. Clayton M. Delphi: A technique to harness expert opinion for critical decision-making tasks in education. *Educ Psychol-UK* 1997;17:373–386.
13. Strøm M, Lönn L, Bech B, et al. Assessment of competence in EVAR procedures: A novel rating scale developed by the Delphi Technique. *Eur J Vasc Endovasc Surg* 2017;54:34–41. [PubMed: 28549712]
14. Diamond IR, Grant RC, Feldman BM, et al. Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol* 2014;67:401–409. [PubMed: 24581294]
15. Hassen YAM, Johnston MJ, Singh P, et al. Key components of the safe surgical ward: International Delphi Consensus Study to identify factors for quality assessment and service improvement. *Ann Surg* 2019;269:1064–1072. [PubMed: 31082903]
16. Doyen B, Maurel B, Cole J, et al. Defining the key competencies in radiation protection for endovascular procedures: a multispecialty Delphi Consensus Study. *Eur J Vasc Endovasc Surg* 2018;55:281–287. [PubMed: 29310896]
17. George D, Mallery P. *SPSS for Windows Step by Step: A Simple Guide and Reference, 11.0 Update*. Allyn and Bacon; 2003.
18. Altieri MS, Yang J, Yin D, et al. Presence of a fellowship improves perioperative outcomes following hepatopancreatobiliary procedures. *Surg Endosc* 2017;31:2918–2924. [PubMed: 27815743]
19. Sheikh MR, Osman H, Butt MU, Jeyarajah DR. Perception of training in hepatopancreatobiliary surgery among general surgery residents in the Americas. *HPB* 2016;18:1039–1045. [PubMed: 27746036]

20. Minter RM, Alseidi A, Hong JC, et al. Training in hepatopancreatobiliary surgery: Assessment of the hepatopancreatobiliary surgery workforce in North America. *Ann Surg* 2015;262:1065–1070. [PubMed: 25751311]
21. Mattar SG, Alseidi AA, Jones DB, et al. General surgery residency inadequately prepares trainees for fellowship: results of a survey of fellowship program directors. *Ann Surg* 2013;258:440–449. [PubMed: 24022436]
22. Osman H, Parikh J, Patel S, Jeyarajah DR. Are general surgery residents adequately prepared for hepatopancreatobiliary fellowships? A questionnaire-based study. *HPB* 2015;17:265–271. [PubMed: 25387852]
23. Ammer-Herrmenau C, Ellenrieder V, Nesses A. [Diagnosis and Treatment of Chronic Pancreatitis]. *Dtsch Med Wochenschr* 2021;146:237–245. [PubMed: 33592659]
24. Willner A, Bogner A, Müsle B, et al. Disease duration before surgical resection for chronic pancreatitis impacts long-term outcome. *Medicine (Baltimore)* 2020;99:e22896. [PubMed: 33126342]
25. Hartford L, Doucet V, Ramkumar J, et al. The impact of a new hepatopancreatobiliary surgery program on the management of pancreatic cancer at Health Sciences North. *Can J Surg* 2019;62:275–280. [PubMed: 31348629]
26. Graham B, Regehr G, Wright JG. Delphi as a method to establish consensus for diagnostic criteria. *J Clin Epidemiol* 2003;56:1150–1156. [PubMed: 14680664]
27. HPB Fellows Grand Rounds Webinars | AHPBA. Available at: <https://www.ahpba.org/educational-webinars/hpb-fellows-grand-rounds-webinars/>. Accessed May 20, 2021.
28. myHPB | IHPBA. Available at: [https://www.ihpba.org/8\\_MyHPB.html?redirect=%2FmyHPB%2F](https://www.ihpba.org/8_MyHPB.html?redirect=%2FmyHPB%2F). Accessed March 15, 2021.



**Figure 1.** Summary of the Delphi process.





**Figure 2.** Agreement consensus percentiles on the final round of survey by domain.

**Table 1.**

## Panelist Societal Affiliation

Panelists	Number (% of all participants)	
	First round	Second and third rounds
Attending surgeons		
SSO	9 (18)	9 (19)
ASTS	9 (18)	8 (17)
AHPBA	12 (25)	12 (25)
GSPD	11 (23)	11 (23)
Fellows		
SSO	2 (4)	2 (4)
ASTS	3 (6)	3 (6)
AHPBA	3 (6)	3 (6)
Total	49	48

AHPBA, Americas Hepato-Pancreato-Biliary Association; ASTS, American Society of Transplant Surgeons; GSPD, general surgery program directors; SSO, Society of Surgical Oncology.

Table 2.

## Curriculum Statements for HPB Fellowship

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus %
Liver, gallbladder, biliary system				
1	Hepatocellular carcinoma (advanced workup): Synthesizing an overall clinical picture (severity of cirrhosis, advanced age, patient functional status, burden of disease, involvement of major vascular structures, and background liver function); navigating multidisciplinary treatment discussions (including the roles of interventional radiologists, HPB surgeons, transplant teams, and medical oncologists); managing viral hepatitis in the perioperative setting	4.85 (0.35)	5 (0)	100
2	Hepatocellular carcinoma (resection): assessment of resectability; evaluating future liver remnant; key operative steps involved in major and minor hepatectomy; optimal margins; methods of intraoperative vascular control; role of MIS liver surgery	4.83 (0.62)	5 (0)	98
3	Optimization of future liver remnant through hepatic molding (including radioembolization, portal vein embolization, hepatic vein embolization, staged resection, ALPPS or hybrid resection-ablation procedure (to include pros and cons for each procedure))	4.81 (0.63)	5 (0)	98
4	Ablation of liver lesions (advanced considerations): Indications for ablation and efficacy vs. resection (in primary liver tumors, NET, and metastatic disease); differences between radiofrequency and microwave ablation; situational advantages between percutaneous vs. operative ablation	4.73 (0.57)	5 (0)	98
5	Hilar cholangiocarcinoma: Assessing resectability; planning drainage of future liver remnant; role of liver transplant in select cases; role of palliative procedures	4.77 (0.68)	5 (0)	96
6	Appropriate management for unresectable hepatic malignancies	4.65 (0.78)	5 (0.25)	96
7	Portal hypertension (advanced): Interventional radiology management of complications (including relative indications/efficacy of TIPS and BRTO); surgical management of complications (including portosystemic decompression treatments and devascularization procedure); implications of portal hypertension on various minor and major abdominal operations	4.54 (0.58)	5 (1)	96
8	Anatomy: Intra-hepatic anatomy of liver and anatomic variations; sinusoidal blood flow and porto-systemic communications	4.65 (0.78)	5 (0)	94
9	Colorectal liver metastases (resection): Assessment of resectability; evaluating future liver remnant; key operative steps involved in major and minor hepatectomy; methods of intraoperative vascular control; role of ablation (in isolation or in combination with resection); optimal margins; role of MIS liver surgery	4.69 (0.79)	5 (0)	94
10	Hepatectomy (advanced considerations): Relative advantages of various parenchymal splitting techniques/technologies; situational indications for different vascular control techniques; management of tumors involving retrohepatic IVC; ALPPS operative technique	4.71 (0.73)	5 (0)	94
11	PSC: Complications and management including indications to screening for cholangiocarcinoma; PTC-D; ERCP with stent; resection; transplantation	4.42 (0.73)	5 (1)	94
12	Post-hepatectomy complications: Anticipating, diagnosing, and managing postoperative hepatic insufficiency, bile leaks, hemorrhage, etc.	4.67 (0.72)	5 (0)	94
13	Polycystic liver disease: Associated abnormalities; presentation; Gigot/Mayo classification schema; treatment options; indications for intervention	4.52 (0.71)	5 (1)	92
14	Hepatocellular carcinoma (diagnosis and basic workup): Screening; potential symptoms; epidemiology; imaging characteristics; differential diagnosis; LIRADS assessment; staging; multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); indications for intervention	4.50 (0.94)	5 (1)	92

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus %
15	Choledochal cysts: Todani classification; risk of malignancy by type; indications for operative intervention; choosing the right operation; indications for transplant; role and limitations of endoscopic therapy	4.58 (0.84)	5 (1)	92
16	Anatomy: Practical understanding of liver surface anatomy, including techniques for mobilizing right and left liver (achieving adequate exposure, identifying and lysing ligamentous attachments, acknowledging and preventing common pitfalls/complications/vascular injury)	4.48 (1.02)	5 (1)	90
17	Congenital liver disease: Pathophysiology, presentation, and evaluation; indications for interventions in pediatric liver disease (including choledochal cysts, biliary atresia, Alagille's syndrome, and congenital hepatic fibrosis)	4.21 (0.79)	4 (1)	90
18	Cholangiocarcinoma essentials: Epidemiology, evaluation, and diagnosis; classification by location (intrahepatic, perihilar, distal); growth patterns; various staging and classification schema (BC, MSK, AJCC, etc.)	4.48 (1.0)	5 (1)	90
19	Colorectal liver metastases (advanced considerations): Management of disappearing lesions; management of synchronous liver/lung disease; sequencing therapy in synchronous liver/colon and liver/rectal disease (chemo/radiation/resection); role of intra-arterial pump therapy	4.56 (0.91)	5 (0.25)	90
20	Neuroendocrine and other metastases to liver: Presentation, epidemiology, evaluation, and diagnosis; role of debulking NET; role of resection in non-colorectal/non-neuroendocrine malignancies	4.48 (1)	5 (1)	90
21*	Gallbladder adenocarcinoma (management): Preoperative workup; assessment of resectability; treatment options, including curative and palliative procedures	4.58 (0.95)	5 (0)	90
22	Pathophysiology of liver failure (including hepatorenal and hepatopulmonary syndromes)	4.31 (0.92)	5 (1)	88
23*	Gallbladder adenocarcinoma (workup): Presentation, epidemiology, evaluation, and diagnosis; multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); staging	4.40 (1.11)	5 (1)	88
24	Adenoma of Ampulla of Vater: Presentation, natural history, epidemiology, evaluation, and diagnosis; resection options and indications, including endoscopic, trans-duodenal resection and reconstruction; respective roles of Whipple vs. ampullectomy	4.46 (1.12)	5 (0.25)	88
25	Non-colorectal, non-NET metastases to liver: Relative prevalence of primary cancers that metastasize to liver; role of resection/liver directed therapy in non-colorectal/non-neuroendocrine malignancies	4.44 (0.86)	5(1)	88
26	Pathophysiology, presentation, and natural history of acquired non-neoplastic liver disease (including hepatitis, cirrhosis, NASH, PSC, PBS)	4.23 (1.03)	4.5 (1)	85
27	Echinococcal liver cyst: Life cycle, epidemiology, target organs, presentation, evaluation; treatment options; indications for intervention; relative advantages of surgical resection vs PAIR (puncture, aspiration, injection, and re-aspiration)	4.15 (0.89)	4 (1)	83
28	PSC: Etiology, pathophysiology, natural history, and patient follow-up	4.15 (0.94)	4 (1)	83
29	Bile duct strictures following cholecystectomy: Evaluation, classification, endoscopic/surgical options and indications	4.27 (1.19)	5(1)	83
30	Hepatotoxicity: Obtaining a working knowledge of common hepatotoxic medications, chemotherapy agents, and other environmental toxins; anticipating, diagnosing, and managing CASH in surgical patients	4.23 (0.9)	4 (1)	81
31*	Managing complications of gallstone disease (advanced considerations): Mirizzi syndrome, gallstone ileus (including role/value of cholecystectomy in addition to enterolithotomy), and recurrent pyogenic cholangitis	4.25 (1.23)	5 (1)	77
32*	Subtotal cholecystectomy: Indications, outcomes, technical considerations (fenestrating vs. reconstituting)	4.10 (1.21)	5 (1.25)	75
	Pancreas, duodenum, and spleen			

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus %
1	Whipple procedure (advanced operative considerations): (a) Techniques for SMV resection/reconstruction and expected outcomes, managing high-risk PJ anastomosis, role/value of frozen sections; (b) adapting to the unexpected discovery of locally advanced disease, adapting to unexpected finding of solitary liver metastasis, value of intraoperative drain placement, management of postoperative pancreatic fistula/bile leak/chyle leak; (c) role of MIS Whipple	4.85 (0.5)	5 (0)	98
2	Distal pancreatectomy (advanced considerations): Value of splenic salvage; techniques for splenic salvage (Warshaw vs. vessel preservation) and their relative outcomes; value of intraoperative drain placement; ideal extent of lymphadenectomy; role of RAMPS technique	4.83 (0.51)	5 (0)	98
3	Unusual pancreatic tumors (primary lymphoma, heterotopia, acinar cell tumors, pancreatoblastoma, hamartoma, metastases): Presentation, epidemiology, evaluation, and diagnosis; multidisciplinary management; preoperative workup; assessment of resectability; operative and nonoperative treatment indications	4.69 (0.62)	5 (0.25)	96
4	Chronic pancreatitis (surgical): Indications for resection/drainage; tailoring operations to pancreatic/ductal anatomy; operative steps of Beger, Frey, and Puestow procedures and their relative success rates and outcomes	4.60 (0.81)	5 (1)	94
5	Endocrine neoplasms (treatment): Non-operative treatment options; indications for surgical resection; preoperative workup; choosing the right operation; prognostic and therapeutic value of lymphadenectomy	4.56 (0.86)	5 (1)	94
6	Pancreatic adenocarcinoma (preoperative planning): Assessing suitability for resection (including societal definitions of borderline resectability and locally advanced disease); considerations for advanced age, obesity, and other comorbidities; advantages/disadvantages of upfront resection vs. neoadjuvant chemotherapy	4.63 (0.78)	5 (0.25)	94
7	Pancreatic adenocarcinoma (advanced workup): Managing preoperative jaundice; adapting treatment to certain radiographic findings (SMV involvement, major arterial involvement, involvement of colon/mesocolon, regional and/or distant lymphadenopathy, distant metastatic disease); indications/efficacy of neoadjuvant therapy	4.67 (0.8)	5 (0)	92
8	Cystic neoplasms (treatment): Indications for endoscopic and surgical management; preoperative workup; treatment options	4.40 (1.06)	5 (1)	90
9	Malignant neoplasm of duodenum (treatment): Assessing suitability for resection (including considerations for advanced age); advantages/disadvantages of upfront resection; indications for diagnostic laparoscopy; operative steps for Whipple procedure; anticipated complications after resection; role and efficacy of palliative operations	4.58 (0.89)	5 (0)	90
10	Endocrine neoplasms (initial workup): Potential symptoms, imaging characteristics, epidemiology, and differential diagnosis; familial syndromes; multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); determining a surveillance plan	4.40 (1.06)	5 (1)	88
11	Benign neoplasms of duodenum: Potential symptoms, imaging characteristics, epidemiology, and differential diagnosis (including adenoma and hereditary familial polyposis); genetics; operative and nonoperative treatment indications; deciding between ampullectomy or Whipple for periampullary lesions	4.40 (1.06)	5 (1)	88
12	Pancreatic adenocarcinoma (operative considerations): Indications for diagnostic laparoscopy; operative steps for Whipple procedure (including artery first approach) and distal pancreatectomy; anticipated complications; role and efficacy of palliative operations	4.46 (1)	5 (1)	85
13*	Malignant neoplasm of duodenum (initial workup): Potential symptoms, imaging characteristics, epidemiology, and differential diagnosis (including adenocarcinoma, GIST, neuroendocrine tumors, and direct invasion of duodenum by adjacent malignancies); multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); staging; indications for surgery	4.38 (1.05)	5 (1)	83
14	Benign ampullary disease: Pancreatobiliary junction anomaly (including workup, management, and risk of biliary cancer); sphincter of Oddi dysfunction (including Rome IV diagnostic criteria and therapeutic options)	4.21 (1.02)	4.5 (1)	83
15	Chronic pancreatitis (TPAT): Indications for islet cell transplantation for small duct pancreatitis and hereditary pancreatitis	4.23 (0.94)	4.5 (1)	81

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus %
16 *	Chronic pancreatitis (interventional): Indications for pancreatic stents; endoscopic/percutaneous drainage procedures; relative success rates for endoscopic/percutaneous procedures	4.19 (1.05)	5 (1)	77
<b>Liver Transplantation</b>				
1	Indications for liver transplantation for liver tumors: Role of transplant in HCC, cholangiocarcinoma, NET, CRLM, and other liver tumors	4.44 (1)	5 (1)	88
2	Managing cholecystitis in the cirrhotic patient	4.27 (1.24)	4 (1)	83
3	Basic technical considerations in transplantation: Mobilizing liver in a cirrhotic, portal dissection, caval dissection for piggyback, etc.	4.06 (1.11)	4 (1)	81
4 *	Managing patients listed for transplant (fluid shifts): Managing hepatic hydrothorax (SPAG diagnosis, medical management, role of drainage, role of TIPS, preventing SBP); managing ascites (SAAG diagnosis, medical management, role of drainage, role of TIPS, treatment of SBP); managing a leaking umbilical hernia	4.04 (1.14)	4 (1)	79
5	Lead and conduct a multi-disciplinary tumor board and conference	Added after 2 <sup>nd</sup> round		
<b>Imaging</b>				
1	Role of MRI-specific contrast agents in evaluating liver lesions (MultiHance, Primovist, superparamagnetic iron oxide agents, etc.)	4.65 (0.85)	5 (0)	94
2	Roles and relative accuracy of various imaging techniques (CT, MRI, ultrasound, EUS, PET) in the evaluation of hepatic and pancreatic cysts/masses	4.54 (0.89)	5 (1)	92
3	Indications for intraoperative ultrasonography of liver/pancreas and technical considerations	4.60 (0.97)	5 (0)	90
4	Indications for intraoperative ICG imaging and technical considerations	4.25 (0.95)	4.5 (1)	83
5	Indications for intraoperative cholangiography and technical considerations	4.40 (1.13)	5 (1)	81
6	Role of ICG deputation in planning liver resections (determining liver function and adequacy of FLR)	4.13 (0.95)	4 (1)	77
<b>Oncology</b>				
1	Radiation therapy (practice): Indications for radiotherapy in HPB malignancies; commonly used modalities; clinical manifestations of toxicity; combination protocols with chemotherapy	4.38 (0.81)	4.5 (1)	94
2	Multi-disciplinary management: Relative roles of surgeons, diagnostic radiologists, interventional radiologists, interventional gastroenterologists, medical oncologists, radiation oncologists, and palliative care teams in treatment of HPB cancers	4.71 (0.82)	5 (0)	92
3	Systemic chemotherapy: Indications for chemotherapy in HPB malignancies; commonly used agents/length of treatment; expected response rates; expected adverse reactions; optimal duration of neoadjuvant chemotherapy	4.46 (0.87)	5 (1)	90
4	Palliative strategies (interventional): Understanding role/indications of enteric and biliary bypass in setting of unresectable disease; appropriate use of enteric feeding tubes (gastric, jejunal, and GI tubes) and relative advantages when compared to TPN; role of duodenal stenting; role of celiac nerve blocks; role of palliative radiation (for both pain and bleeding)	4.54 (0.82)	5 (1)	88
5	End-of-life care: Effectively and empathetically addressing goals of care with patients and family members (including role of DNR/DNI status); setting realistic expectations when faced with end-stage clinical scenarios (obstruction in setting of peritoneal carcinomatosis, hepatic failure with extensive liver disease, etc.); understanding concepts of medical futility and appropriate allocation of resources	4.56 (0.81)	5 (1)	88

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus %
6*	Determination of patient's functional status prior to administration of chemotherapy including ECOG performance status and Karnofsky Performance status	4.17 (1.14)	5 (1)	79
7	Immunotherapeutic agents: Mechanism of action of monoclonal antibodies and their targets; indications for use; expected adverse reactions	4.10 (0.92)	4 (1)	79
8	Hepatic artery infusion pumps: Indications and contraindications; patient preparation; technical aspects of implantation; postoperative care; potential complications	4.15 (0.91)	4 (1)	79
9	Palliative strategies (non-interventional): Use of quality-of-life assessment tools; incorporating psychological evaluation and depression screening into treatment plans; pain control strategies; medical therapies for nausea; directing patients to educational resources and support groups as appropriate	4.29 (0.93)	5 (1)	79
<b>Trauma, Bile Duct Injury</b>				
1	Bile duct injury (advanced considerations): Considerations in repairing type E4 injuries	4.83 (0.37)	5 (0)	100
2	Bile duct injury (advanced considerations): Role of transplant after bile duct injury	4.75 (0.43)	5 (0.25)	100
3	Bile duct injury (management): Role of ERCP/sient/PTC-D; principles and techniques of biliary reconstruction; management of complications (including stenosis, anastomotic leakage, and peritoneal sepsis)	4.54 (0.93)	5 (1)	92
4*	Liver trauma (advanced technical considerations): Selective vessel ligation; advanced hemostatic agents (energy, mechanical, chemical); indications and principles of total vascular exclusion (+/- IVC shunt or venovenous bypass) for retrohepatic IVC and/or hepatic vein injuries; role of transplant in hepatic trauma	3.96 (1.17)	4 (1)	77
5*	Pancreatic trauma (management): Role of IR drainage; indications for operative exploration; indications for distal pancreatectomy (including role/value of splenic salvage); indications for trauma Whipple; role/value of intraoperative drain placement; outcomes and complications after pancreatic resections in trauma	3.88 (1.24)	4 (2)	73
6	Management of complications of ERCP (including duodenal perforation, bleeding, stricture) and role of operative or interventional radiology management		New Statement	
<b>Psychomotor</b>				
1	Intraoperatively assessing tumor extent (using visualization, palpation, intraoperative ultrasound, frozen sections, etc.) to achieve adequate margin control	4.83 (0.51)	5 (0)	98
2	Indications and technical considerations for vascular reconstruction in transplant and oncological surgery (including autogenous and synthetic options for vascular grafting)	4.77 (0.47)	5 (0)	98
3	Appropriate selection of patients for open vs. laparoscopic vs. robotic HPB surgery based on tumor size, location, vascular involvement, patient factors, comorbidities, obesity, previous surgery	4.81 (0.44)	5 (0)	98
4	Appropriate positioning of patient for open HPB surgery: Employment of self-retaining retractors; using gravity to optimize exposure; making special considerations for obese patients; communicating with assistant to optimize retraction	4.67 (0.77)	5 (0)	96
5	Appropriate positioning of patient for laparoscopic HPB surgery: Principles of port placement; strategies for liver retraction (if appropriate); using gravity to optimize exposure; communicating with assistant to optimize retraction	4.75 (0.66)	5 (0)	96
6	Principles of bleeding control during open HPB surgery: Developing tailored strategy for major and minor bleeding (including preferences for suture/energy/mechanical/chemical hemostasis); working knowledge of available hemostatic agents and technologies	4.75 (0.75)	5 (0)	96
7	Principles of bleeding control during laparoscopic and robotic HPB surgery	4.73 (0.76)	5 (0)	96



Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus %
8	Appropriate port site placements for laparoscopic HPB procedures	4.69 (0.77)	5 (0)	96
9	Intraoperative evaluation of resectability for HPB malignancies	4.77 (0.65)	5 (0)	96
10	Ablation and associated techniques; Using ultrasound to direct ablation antenna into target lesion; avoiding thermal injury to surrounding structures; appropriately tailoring power and duration to lesion size	4.69 (0.65)	5 (0)	94
11	Advanced anesthesia considerations: Situational monitoring/manipulation of CVP; hypovolemic phlebotomy; use of bypass pumps for caval/transplant surgery, etc.	4.60 (0.67)	5 (1)	94
12	Utility of various abdominal wall incisions (including midline laparotomy, subcostal, Makuchi, etc., and extended variations)	4.60 (0.95)	5(0)	92
13	Appropriate port site placements for robotic HPB procedures	4.48 (0.76)	5 (1)	88
14*	Anesthesia considerations: Regional/neuraxial block options; indications for lidocaine drip; methods of reducing postoperative narcotic use; other ERAS considerations	4.38 (0.88)	5 (1)	88
15	Appropriate positioning of patient for robotic HPB surgery: Principles of port placement; strategies for liver retraction (if appropriate); using gravity to optimize exposure; communicating with assistant to optimize retraction (where robotic HPB is performed)	4.42 (0.81)	5 (1)	83

\* included in curricula for both general surgery residency and HPB fellowship.

AJCC, The American Joint Committee on Cancer; ALPPS, associating liver partition and portal vein ligation for staged hepatectomy surgery; BC, Bismuth-Corlette; BRTO, balloon-occluded retrograde transvenous obliteration; CASH, chemotherapy-associated steatohepatitis; CRLM, colorectal liver metastasis; CVP, central venous pressure; ECOG, Eastern Cooperative Oncology Group; ERAS, Enhanced recovery after surgery; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound, FLR, future liver remnant; GIST, gastrointestinal stromal tumor; HCC, hepatocellular carcinoma; HPB, hepatopancreatobiliary; ICG, indocyanine green; IR, interventional radiology; IVC, inferior vena cava; LJRADS, liver imaging reporting and data system; MIS, minimally invasive surgery; MSK, Memorial Sloan-Kettering; NASH, nonalcoholic steatohepatitis; NET, neuroendocrine tumor; PAIR, puncture, aspiration, resection; PBS, primary biliary cirrhosis; PET, positron emission tomography; PSC, primary sclerosing cholangitis; PTC-D, percutaneous transhepatic cholangiography and drainage; RAMPS, radical antegrade modular pancreatosplenectomy; SAAG, serum-ascites albumin gradient; SBP, spontaneous bacterial peritonitis; SMV, superior mesenteric vein; SPAG, serum-pleura-albumin gradient; TIPS, transjugular intrahepatic portosystemic shunt; TPIAT, total pancreatectomy and islet autotransplantation.

**Table 3.**

**Curriculum Statements for General Surgery Residency**

<b>Subject, n</b>	<b>Statement</b>
Liver, gallbladder, biliary system	
1	Anatomy: Extra-hepatic anatomy of liver (including surface anatomy, ligaments, and relationship with adjacent and surrounding structures)
2	Embryology of liver and biliary tract (including potential anomalies)
3	Physiology: Physiology and pathophysiology of bilirubin metabolism and coagulation cascade
4	Simple liver cysts: Presentation; evaluation; imaging characteristics distinguishing simple cysts from cystic neoplasms; treatment options; indications for intervention
5	Liver abscess: Presentation, evaluation, treatment options, and indications for intervention
6	Benign neoplasms of the liver: Presentation, typical imaging characteristics of hemangioma/FNH/adenoma, evaluation, and diagnosis; treatment options; role of surveillance; indications for intervention
7	Colorectal liver metastases (basic workup): Presentation; epidemiology; surveillance protocols; typical imaging characteristics; staging; roles of CT/MRI/PET; prognosis with stage IV disease
8	Gallstone disease (basic considerations): Presentation, evaluation, treatment options, and indications for intervention in asymptomatic gallstone, biliary colic, cholecystitis, choledocholithiasis, and cholangitis
9	Gallbladder polyps: Presentation; natural history; indications for resection; principles of resection
10	Portal hypertension (basics): Etiology, pathophysiology, presentation, and evaluation
11*	Subtotal cholecystectomy: Indications, outcomes, and technical considerations (fenestrating vs. reconstituting)
12*	Gallbladder adenocarcinoma (workup): Presentation, epidemiology, evaluation, and diagnosis; multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); staging
13*	Gallbladder adenocarcinoma (management): Preoperative workup; assessment of resectability; treatment options, including curative and palliative procedures
14*	Managing complications of gallstone disease (advanced considerations): Mirizzi syndrome; gallstone ileus (including role/value of cholecystectomy in addition to enterolithotomy); recurrent pyogenic cholangitis
Pancreas, duodenum, and spleen	
1	Anatomy: Anatomy of pancreas, duodenum, portal structures, retroperitoneum, and adjacent organs
2	Physiology: Endocrine and exocrine functions of pancreas; duodenal physiology
3	Embryology of pancreas, pancreatic duct, and duodenum (and potential anomalies, including pancreas divisum and annular pancreas)
4	Pancreatic divisum: Potential symptoms and workup
5	Clinical biochemical tests of pancreatic function and their interpretation: Markers of pancreatic injury; measures of pancreatic exocrine function; urinary and serum neuroendocrine hormones
6	Acute pancreatitis (mild): Diagnosis, medical management, indications, and timing for cholecystectomy; post-discharge follow-up

Subject, n	Statement
7	Acute pancreatitis (severe): Definition; diagnosis and management of local and systemic complications, including percutaneous drainage and operative debridement
8	Chronic pancreatitis (medical): Pathogenesis, staging, prognosis, and pain control
9	Cystic neoplasms (initial workup): Potential symptoms, imaging characteristics, epidemiology, and differential diagnosis; multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); determining a surveillance plan
10	Pancreatic adenocarcinoma (initial workup): Potential symptoms, epidemiology, and differential diagnosis; appropriate staging imaging and common imaging characteristics; multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy)
11	Duodenal ulcer disease (basics): Pathogenesis, investigation, and diagnosis; operative and nonoperative treatment indications
12	Spleen (cystic lesions): Evaluation and management of splenic abscesses, simple cysts, hydatid cysts, and other cystic lesions; indications for medical, interventional, and surgical therapy
13	Spleen (hematological disease): Indications for splenectomy in patients with ITP, spherocytosis, hemolytic anemia, lymphoproliferative disorders, and other hematologic disease; implications for postoperative OPSI risk
14	Duodenal disease: Diagnosis and treatment of non-healing duodenal ulcers; etiologies and management of chronic duodenal fistulae
15	Spleen (solid lesions): Evaluation and management of splenic lymphoma, angiosarcoma, lymphangiosarcoma, splenic metastases, and other solid lesions of the spleen
16	Spleen (direct extension of other LUQ disease): Indications for en bloc resection vs. spleen-preserving procedures for tumors of adjacent organs
17*	Chronic pancreatitis (interventional): Indications for pancreatic stents; endoscopic/percutaneous drainage procedures and their relative success rates
18*	Malignant neoplasm of duodenum (initial workup): Potential symptoms, imaging characteristics, epidemiology, and differential diagnosis (including adenocarcinoma, GIST, neuroendocrine tumors, and direct invasion of duodenum by adjacent malignancies); multidisciplinary risk assessment (including techniques, accuracy, and potential complications of biopsy); staging; indications for surgery
Liver transplantation	
1	Indications for liver transplantation (liver failure): Common causes of liver failure; clinical presentation of both acute and chronic liver failure; CTP and MELD scores
2*	Managing patients listed for transplant (fluid shifts): Managing hepatic hydrothorax (SPAG diagnosis, medical management, role of drainage, role of TIPS, preventing SBE); managing ascites (SAAG diagnosis, medical management, role of drainage, role of TIPS, treatment of SBBP); managing a leaking umbilical hernia
Imaging	
1	Applied physics and technology of ultrasound, Doppler, CT, MRI, and PET
2	Applied physics and technology of nuclear medicine imaging procedures, including biliary excretion scan (HIDA), RBC scan, Octreotide scan, and L/S scan
Oncology	
1	Basic pathophysiology of neoplasia: Mechanisms of carcinogenesis, genetic alterations, viral carcinogenesis, chronic inflammation, tumor biology (including potential for metastases)
2	Systemic chemotherapy (theory): Major classes of chemotherapeutics and their mechanisms of action
3*	Determination of patient's functional status prior to administration of chemotherapy (including ECOG performance status and KP status)
Trauma, bile duct injury	
1	Liver trauma (blunt): Common mechanisms of blunt hepatic trauma; physical exam findings; appropriate imaging and grading of liver injury; role of interventional radiology/embolization; indications for operation

Subject, n	Statement
2	Liver trauma (penetrating): Role of non-operative management in penetrating RUQ injuries; indications for surgery (hemodynamic instability, tenderness away from site, visceral evisceration, etc.)
3	Liver trauma (basic technical considerations): Proper employment of Pringle maneuver; hepatorrhaphy; perihepatic packing; delayed/staged/damage control procedures
4	Bile duct injury (diagnosis and workup): Clinical presentation; appropriate imaging (including roles of CT/MRCP/HIDA/ERCP/PTC); classification by level; identification of associated injuries; implication of associated vascular injury
5	Pancreatic trauma (diagnosis): Mechanisms of injury; presentation; diagnosis; identification of pancreatic duct disruption (including role of ERCP); potential complications of non-operative management (pancreatic fistula, acute pancreatitis, pancreatic pseudocyst, etc.)
6	Duodenal trauma: Diagnosis and grading of duodenal injuries; management of duodenal injury by grade; role of pyloric exclusion; role of intraluminal duodenal drain placement
7	Splenic trauma: Mechanisms of injury for blunt and penetrating trauma; presentation; diagnosis; classification of spleen injury; indications for splenectomy
8	Management of liver injury in post-partum patients, including associated liver rupture, bleeding, etc
9*	Liver trauma (advanced technical considerations): Selective vessel ligation; advanced hemostatic agents (energy, mechanical, chemical); indications and principles of total vascular exclusion (+/- IVC shunt or venovenous bypass) for retrohepatic IVC and/or hepatic vein injuries; role of transplant in hepatic trauma
10*	Pancreatic trauma (management): Role of IR drainage; indications for operative exploration; indications for distal pancreatectomy (including role/value of splenic salvage); indications for trauma Whipple; role/value of intraoperative drain placement; outcomes and complications after pancreatic resections in trauma
Psycho-motor	
1*	Anesthesia considerations: Regional/neuraxial block options; indications for lidocaine drip; methods of reducing postoperative narcotic use; other ERAS considerations

\* Included in curricula for both general surgery residency and HPPB fellowship.

CTP, Child-Turcotte-Pugh; ECOG, Eastern Cooperative Oncology Group; ERAS, Enhanced recovery after surgery; ERCP, endoscopic retrograde cholangiopancreatography; FNH, focal nodular hyperplasia; GIST, gastrointestinal stromal tumor; HIDA, hepatobiliary iminodiacetic acid; ITP, Idiopathic thrombocytopenic purpura; IVC, inferior vena cava; KP, Karnofsky Performance; LUQ, left upper quadrant; MELD, model for end-stage liver disease; MRCP, magnetic resonance cholangiopancreatography; OPSI, overwhelming postsplenectomy infection; PET, positron emission tomography; PTC, percutaneous transhepatic cholangiography; RBC, red blood cell; RUQ, right upper quadrant; SAAG, serum-ascites albumin gradient; SBE, spontaneous bacterial empyema; SBP, spontaneous bacterial peritonitis; SPAG, serum-pleura- albumin gradient; TIPS, transjugular intrahepatic portosystemic shunt.

**Table 4.**  
Curriculum Statements for Further Subspecialized Interests beyond HPB Fellowship

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus
Liver, gallbladder, biliary system				
1	Hepatic masses in pediatric population: Common etiologies (hepatoblastoma, HCC, sarcoma, etc.); prognosis; indications for resection and transplantation	4.06 (0.97)	4 (2)	73
Pancreas, duodenum, and spleen				
1	Congenital disorders of pancreas and duodenum, including annular pancreas, pancreatic divisum and pseudodivisum, duodenal atresia, duplication, and duodenal diverticula; investigation and diagnosis; operative and nonoperative treatment indications	4.04 (1.12)	4 (1.25)	75
Liver transplantation				
1	Viral hepatitis: Management of hepatitis B/C before and after liver transplant; indications for antiviral therapy; timing/duration of therapy	3.85 (1.10)	4 (2)	73
2	Vascular/biliary complications of transplantation: Hepatic artery thrombosis (incidence, early/late presentation, and management); portal vein thrombosis; biliary strictures/leaks; venous outflow obstruction	3.96 (1.27)	4 (2)	73
3	Managing patients listed for transplant (organ failure): Hepatorenal syndrome (epidemiology, medical management, indications for simultaneous liver/kidney transplant, role of "safety-net" allocation after liver transplant); hepatopulmonary syndrome (epidemiology, role of screening, medical management, relationship with portopulmonary hypertension)	3.94 (1.21)	4 (2)	69
4	Organ procurement DBD: Medical and surgical issues of brain-dead donors	3.73 (1.44)	4 (2)	69
5	Recipient assessment: Implications of recipient age; medical comorbidities; malignancies; viral/bacterial infections; understanding substance abuse (addiction, treatment options, implicit bias)	3.79 (1.44)	4 (2)	69
6	Advanced technical considerations in transplant surgery: Dealing with mismatched vascular/biliary anastomoses; biliary reconstruction when transplanting for PSC; challenges in re-transplantation	3.88 (1.39)	4.5 (2)	69
7	Donor assessment: Implications of donor age; medical comorbidities; malignancies; viral/bacterial infections; how much steatosis to tolerate in the donor allograft	3.73 (1.50)	4 (2)	67
8	Split liver transplant: Importance of anatomical variants (replaced left hepatic artery, LSHV-IVC junction, etc.); in-situ and ex-situ splitting techniques; coordinating procurement and implantation of both grafts; common complications	3.83 (1.36)	4 (2)	67
9	Organ procurement DCD: Recovery of abdominal organs from donation after cardiac death donors; differences in outcome after transplant from DCD vs. DBD	3.67 (1.48)	4 (2)	65
10	Organ preservation: Basic pathophysiology of ischemia and reperfusion; differences of most commonly used solutions (UW vs. HTK); advantages of pulsatile preservation over static cold storage	3.65 (1.45)	4 (2.25)	65
11	Pediatric liver transplant: Common indications (biliary atresia, fulminant hepatic failure, autoimmune hepatitis, liver tumors); technical challenges of dealing with smaller vessels (anastomoses, graft use); expected complications	3.58 (1.54)	4 (3)	60
12	Ethics surrounding living donor transplant	3.54 (1.38)	4 (2)	60
13	Pancreas transplant: Role of solitary pancreas transplant in Type 1 DM; indications for combined pancreas/kidney transplant; technical considerations in pancreas transplant; common postoperative complications	3.58 (1.46)	4 (2.25)	58

Subject, N	Statement	Mean (SD)	Median (IQR)	Consensus
14	Ethics surrounding DBD: Uniform Determination of Death Act; criteria for brain death	3.46 (1.41)	4 (2,25)	58
15	Ethics surrounding DCD: Controlled DCD protocols; utilization of donor hearts after DCD; uncontrolled DCD protocols	3.44 (1.43)	4 (3)	58
16	Immunological complications of transplantation: Post-transplant lymphoproliferative disorders; skin cancer; recurrence of HCC	3.50 (1.38)	4 (3)	56
17	Major Histocompatibility Complex: Structure and function of HLA; clinical significance of anti-HLA antibodies	3.58 (1.24)	4 (3)	54
18	Immunosuppression: Drugs, mechanisms of action, toxicities, and combination therapy	3.40 (1.44)	4 (3)	54
19	Immunobiology of transplantation and rejection (basic concepts): donor-recipient matching	3.58 (1.32)	4 (2,25)	52
20	Acute rejection of the liver allograft: Clinical, laboratory, and histologic presentation	3.52 (1.40)	4 (3)	52
21	Infectious complications of transplantation: Infections in immunocompromised hosts	3.52 (1.40)	4 (3)	52
22	Infectious complications of transplantation: donor-transmitted infections	3.52 (1.70)	4 (3)	52
23	Hyperacute rejection: Clinical significance; basic immunological mechanisms; therapies available for treatment and prevention; implications for ABO incompatible and crossmatch positive transplants	3.48 (1.35)	3.5 (3)	50
Imaging				
1	Indications for post-transplantation Doppler and technical considerations	4.10 (1.21)	5 (2)	73
Oncology				
1	Monitoring during chemotherapy: Assessment and grading of adverse effects; changes in performance status; appropriate laboratory parameters prior to each cycle	3.67 (1.20)	4 (2)	67
2	Radiation therapy (theory): Applied physics and technology; mechanism of action of XRT, SBRT, and other modes of therapeutic radiation	3.81 (1.01)	4 (2)	65
Trauma, bile duct injury				
1	Special considerations in pediatric HPB trauma: Influence of patient age on threshold for laparotomy; indications for transverse rather than longitudinal laparotomy; alterations in surgical management/technique due to patient size	3.69 (1.18)	4 (2)	60

DBD = donation after brainstem death; DCD = donation after circulatory death; DM = diabetes mellitus; HCC = hepatocellular carcinoma; HLA = human leukocyte antigen; HPB = hepatopancreatobiliary; HTK = histidine-tryptophan-ketoglutarate; IVC junction: left suprahepatic vein and inferior vena cava junction; LSHV- UW = University of Wisconsin; PSC = primary sclerosing cholangitis; SBRT = stereotactic body radiation therapy; XRT = radiation therapy.