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Screening and management of viral hepatitis and hepatocellular carcinoma in Mongolia: results from a survey of Mongolian physicians from all major provinces of Mongolia

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ABSTRACT

Background: According to Globocan, Mongolia has the highest worldwide hepatocellular carcinoma (HCC) incidence (78.1/100 000, 3.5× higher than China).

Aims and methods: We conducted an anonymous survey of physicians from major provinces who attended an educational liver symposium, analysing their demography, practice, knowledge, perceptions and proposed solutions. Multivariate logistic regression was used to estimate OR relating demography and practice factors with higher provider knowledge and improvement.

Results: Of the 121 attendees, 44–95 (36–79%) responded to each question. Most were female (87%), young (79% age <50), subspecialists (81%), university-affiliated (74%), and practised in urban areas (61%). The mean pretest and post-test scores per physician were 60.4±20.4 and 65.6±21.3, with no observed significant predictors for baseline knowledge or improvement. Most (>80%) noted that <50% of patients who need hepatitis or HCC screening receive it. The main perceived barriers to screening were inability to pay for tests, lack of guidelines and poor patient awareness. Hepatitis treatment rates were low; 83% treated hepatitis C virus in <10 patients in the past year, and 86% treated hepatitis B virus in <10 patients/month. Treatment barriers were multifactorial, with cost as a principal barrier. Proposed solutions were universal screening policies (46%), removal of financial barriers (28%) and provider education (20%).

Conclusions: Physicians from major regions of Mongolia noted low screening for viral hepatitis, even lower treatment rates, financial barriers and the need for increased educational efforts. We advocate broad-based medical education tailored to local needs and based on needs assessment and outcome measurements.

Summary box

What is already known about this subject?

- Mongolia has the highest hepatocellular carcinoma (HCC) incidence in the world (78.1/100,000, 3.5× higher than China). As a result, the Mongolia government has launched The National Viral Hepatitis Program, which is a comprehensive program that involves all aspects from prevention to care and disease control to meet a reduction goal for morbidity and mortality due to HBV, HDV and HCV (the three primary causes of HCC in Mongolia). Consequently, access to antiviral therapies is now improving in Mongolia.

What does this study add?

- For the first time, we formally and anonymously evaluated physician's knowledge of liver disease, readiness to treat with the newer therapies, their perceptions on barriers to screening, diagnosis and treatment, and proposed solutions in a sample of physicians from both urban and rural practices and from all major provinces of Mongolia. This work outlines a practical process and simple provider survey methodology and format that can be applied to other developing countries for needs assessment that can also be applicable to a variety of topics, as formal needs assessment is important to obtain data to guide future educational and research efforts and to assist with resource allocation to improve access to care as well as to expand the current levels of care.

How might this impact on clinical practice?

- The survey showed that, in addition to removal of financial barriers for screening, diagnosis and treatment in low and middle income countries, provider knowledge and comfort with the management of diseases are also very important. Understanding provider educational needs and targeting programs according to specific knowledge and access gaps identified will set the foundation for expanding care efficiently and effectively.

INTRODUCTION

Currently, on a global scale, viral hepatitis is a significant cause of death.[1] Mongolia has the highest worldwide hepatocellular carcinoma (HCC) incidence in the world (78.1/100 000), according to Globocan.[2] This incidence is three and a half times higher than in China, and six times higher than the global average. In a small low to middle income country of 2 992 908 people with a gross domestic product (GDP) of $11 900 per capita, liver disease causes substantial morbidity and mortality.[3] The number one cause of cancer-related death was HCC, responsible for 44% of male and 42% of female cancer deaths.[4 5] In addition, data from the National Cancer Registry of Mongolia found that the leading cause of cancer was also HCC in both genders (41% of male cancers; 33% of female cancers).[4] Furthermore, the incidence of HCC has increased from 10 to 60 per 100 000 from the 1960s to 2010.[5] In 2014, the liver cancer morbidity and mortality were 64.4 and 47.4 per 100 000 persons according to the Center for Health Development Health Indicators report.[6] In a retrospective study conducted with 195 consecutive patients with HCC from four hospitals in Ulaanbaatar in 2012, the primary aetiologies of HCC were found to be hepatitis C virus (HCV) (45.6%), hepatitis B virus (HBV) (34.4%), HBV and HCV dual infection (14.4%) and alcoholic liver disease (5.6%).[7]

Mongolia introduced HBV vaccination into routine immunisation schedules for newborns and children under 1 year of age in 1991, which substantially decreased the incidence of HBV infection.[8] In addition, an randomised controlled trial (RCT) shows that the drug tenofovir disoproxil fumarate (TDF) can safely prevent vertical transmission of HBV, and could further improve this decrease in HBV infection.[9] The WHO supported a series of national serological surveys and found that Mongolia reached its regional goal, with 82% of children fully vaccinated as of 2010.[7] The hepatitis B surface antigen (HBsAg) carrier rate was 0.53 among 5894 children aged 4–6 years in 2009–2010.[7] However, the prevalence of HBV is still high among adults. A review of studies from 2000 to 2011 found an HBV seroprevalence of 11.8% in the unvaccinated population.[5] Approximately 13.6% of those who are HBsAg-positive also have coinfection with the hepatitis D virus (HDV), which speeds progression of liver disease.[10–12]

The prevalence of HCV, the other leading cause of HCC, was also found to be high at 15%.[5] Although HCV can now be cured with new direct-acting antiviral (DAA) therapies, the morbidity and mortality are still high, due to delayed diagnoses and poor access to newer medications. The seroprevalence of dual infection with HBV and HCV was found to range from 5.3% to 22.9% in the published literature.[5 13–18]

Access to antiviral therapies is now improving in Mongolia. The HCV DAAs, sofosbuvir and a fixed-dose combination of ledipasvir and sofosbuvir (LDV/SOF), have been registered and are available at lower costs.[19 20] In addition, TDF for the treatment of HBV is also more affordable based on a new tiered pricing strategy.[19 20] In response, the Mongolian Ministry of Health and Sports (MOHS) has recently developed hepatitis C diagnosis and treatment guidelines for medical practitioners, and is currently working on updating hepatitis B guidelines.[19 20] However, there are no current data on physician awareness and management of this important disease, and whether these physicians possess knowledge on the optimal use of these newer therapies.

Our goal was to evaluate Mongolian physicians' knowledge of liver disease, their comfort level in the management of liver disease, their access and perceived barriers to screening, diagnosis and treatment and their proposed solutions.

METHODS

Study design

We conducted an anonymous survey of physicians from all major provinces of Mongolia who attended a 2-day continuing medical education liver symposium in Ulaanbaatar, Mongolia in 21–22 September 2015. During the symposium, international experts in liver disease led interactive sessions on hepatitis viruses (HBV, HCV, HDV), end-stage liver disease (ESLD) and HCC. Local hepatologists led and moderated the case study discussions after each module and administered the survey in the Mongolian language.

Surveys were administered at regular intervals throughout the sessions to evaluate the following:

1. Demographic and medical practice;
2. Knowledge (pretest and post-test to assess baseline knowledge and improvement, and case study questions for each module) and perceived familiarity on liver disease management;
3. Perceived barriers to screening, diagnosis and treatment;
4. Proposed solutions.

We administered paper surveys for the demographic and practice questions, and the audience response system (ARS) was used for the remaining surveys to display and record and tabulate answers. We were able to match the demographics of the participants with their responses to the ARS by recording the ARS handheld device number on the paper surveys. All written materials including paper surveys, slides of survey questions, lecture slides and course syllabus were in the Mongolian language. Lecture slides were presented both in English and Mongolian. Mongolian hepatologists reviewed the medical integrity of the translated course material and survey to ensure proper wording and translation. Survey questions were read by Mongolian hepatology experts in Mongolian to participants. All lectures were conducted in English with parallel live translation into Mongolian by Mongolian physicians serving as translators.

Statistical analysis

Summary statistics were performed on all surveys using STATA (StataCorp LP, College Station, Texas, USA). Scores for knowledge-based questions were calculated as a percentage of correct answers for all questions in those who answered ≥1 question. Multivariate logistic regression was used to estimate OR relating factors such as physician demography, practice setting, perceived comfort with managing liver disease with higher provider knowledge (>50% score) and improvement. We also evaluated predictors of perceived comfort with managing liver disease. This study received an Institutional Review Board exemption from the Panel on Human Subjects at Stanford University, Stanford, California, USA.

RESULTS

A total of 121 physicians attended the symposium representing all major regions of Mongolia. Most were female (86.9%), age ≤50 (78.5%), subspecialists (81.1%), university affiliated (74.0%), and practised in urban versus rural areas (61.2% vs 38.8%) (table 1).

A majority of physicians (78.1%) manage more than 10 patients per week with liver disease, with 40.0% of physicians seeing more than a quarter with HCV, and 33.7% seeing more than a quarter with HBV (table 2).

Table 1 Baseline demographics of the physician attendees

	N (%)
Gender (n=107)	
Male	14 (13.1)
Female	93 (86.9)
Age range (n=107) (years)	
20–30	11 (10.3)
31–40	29 (27.1)
41–50	44 (41.1)
51–60	19 (17.8)
61–70	4 (3.7)
≥71	0 (0)
Years of practice (n=106)	
0–10	30 (28.3)
11–20	30 (28.3)
21–25	19 (17.9)
26–35	23 (21.7)
≥36	4 (3.8)
Specialty (n=106)	
Family medicine	0 (0)
Internal medicine	19 (17.9)
Gastroenterology	34 (32.1)
Hepatology	8 (7.6)
Infectious disease	38 (35.9)
Paediatrics	1 (0.9)
Primary medicine practice (n=102)	
Referral government hospital	28 (27.5)
General government hospital	53 (52.0)
Referral private hospital	3 (2.9)
General private hospital	12 (11.8)
General primary care public clinic	5 (4.9)
University affiliation (n=100)	
Yes—university on campus/trainees involved	29 (29.0)
Yes—university unattached/trainees not involved	44 (44.0)
Not affiliated	26 (26.0)

Knowledge and perceived familiarity with liver disease management

Of the 121 attendees, 44–89 (36.4–73.6%) responded to each question of the 12 pretest and post-test questions and 30 case study questions. The majority (50–75%) of physicians answered 58.3% of the pretest questions, 91.7% of the post-test questions and 73.3% of the case study questions. The mean pretest and post-test scores per physician were 60.4±20.4 and 65.6±21.3, with no observed significant predictors for high baseline knowledge or improvement. Of the case questions, the correct percentage for answers was: 41.4±17.4 for HBV, 33.6 ±19.8 for HCV, 70.5±24.1 for HDV, and 36.5±20.7 for ESLD/HCC. The treatment-related questions were more challenging: 12.2% correctly answered a HBV treatment question, 29.6% correctly answered a question about HCV direct-acting agents and only 15.4% were aware of anaemia as an adverse event with ribavirin treatment. However, most (66.5%) indicated that they were comfortable with liver disease management. Those who practised in urban settings were more likely to feel comfortable with initiating HCV treatment (OR=3.49; 95% CI 1.15 to 10.57). No significant predictors for comfort with HBV treatment were identified.

Access to screening and treatment and perceived barriers

The main perceived barriers to screening were inability to pay for diagnostic tests, lack of clinical guidelines and poor patient awareness. The major HCC screening barrier was also cost (37.0%) (table 3).

Hepatitis treatment rates were low; 83.3% treated HCV in <10 patients in the past year and 86.3% treated HBV in <10 patients/month. Treatment barriers were multifactorial, with medication cost as the principal barrier (table 4).

Priorities for screening and management

Physician responses on priorities for hepatitis screening and treatment aligned with treatment guidelines, with the majority noting that all high-risk patients should be screened and treated. However, only 14.8% of physicians noted that all patients should be treated for HCV and only 48.4% believed that all patients should be screened for HBV (tables 5 and 6).

Proposed solutions

Overall, top proposed solutions to improve liver disease management were universal screening policies (46.4%), removal of financial barriers (27.5%), provider

Table 2 Characteristics of physician practices

	N (%)
Size of facility (n=102)	
≥500 bed hospital	12 (11.8)
300–500 bed hospital	16 (15.7)
100–300 bed hospital	34 (33.3)
≤100 bed hospital	9 (8.8)
2–5 physician clinics	6 (5.9)
≥11 physician clinics	3 (2.9)
Location of practice (n=103)	
Rural	40 (38.8)
Urban	63 (61.2)
Patients with liver disease seen per week (n=105)	
<10	23 (21.9)
11–30	41 (39.1)
31–50	17 (16.2)
51–75	6 (5.7)
76–100	6 (5.7)
101–150	7 (6.7)
>150	5 (4.8)
Percentage of patients with liver disease with HCV (n=105)	
<10	20 (19.1)
11–25	43 (41.0)
26–50	33 (31.4)
51–75	9 (8.6)
76–100	0 (0)
Percentage of patients with liver disease with HBV (n=104)	
<10	23 (22.1)
11–25	46 (44.2)
26–50	28 (26.9)
51–75	6 (5.8)
76–100	1 (1.0)
Percentage of patients with liver disease with HDV/HBV coinfection (n=103)	
<10	67 (65.1)
11–25	27 (26.2)
26–50	7 (6.8)
51–75	2 (1.9)
76–100	0 (0)
Percentage of patients with liver disease with compensated cirrhosis (n=103)	
<10	36 (35.0)
11–25	35 (34.0)
26–50	27 (26.2)
51–75	5 (4.9)
76–100	0 (0)
Percentage of patients with liver disease with decompensated cirrhosis (n=103)	
<10	49 (47.6)
11–25	22 (21.4)
26–50	23 (22.3)
51–75	5 (4.9)
76–100	4 (3.9)
Percentage of patients with liver disease with HCC (n=101)	
<10	77 (76.2)
11–25	18 (17.8)
26–50	3 (3.0)
51–75	3 (3.0)
76–100	0 (0)

HBV, hepatitis B virus; HCC, hepatocellular carcinoma; HCV, hepatitis C virus; HDV, hepatitis D virus.

education (20.3%) and patient education (5.8%). Physicians rated many provider educational efforts as helpful, including in-person conferences, web-based seminars and videoconferences (figure 1). For disease screening in particular, these physicians rated local health fairs and technology-based solutions, such as mobile applications, highly (figure 2).

DISCUSSION

This was the first published study on Mongolian physician knowledge of liver disease management and treatment, and the first to publish these physicians' perceptions of barriers and priorities, as well as their proposed solutions.

Despite their eagerness to screen and treat patients for liver disease, physicians from all major regions of Mongolia noted low screening for viral hepatitis (<50%) and even lower treatment rates (>80% treated <10 patients/year). The main contributing factors were financial and educational in nature. Recommendations based on physician feedback and information gathered at the symposium are presented below.

Reimbursement policies for HBV are variable in the Asia-Pacific region.[21] The financial barriers are being addressed by the availability of antiviral medications at lower costs with a tiered pricing strategy. A fixed-dose combination of LDV/SOF costs US$400/month in Mongolia and generic TDF is available at US$25/month for HBV-infected pregnant women.[14] These costs are expected to decrease further in the near future, as the manufacturer has signed non-exclusive licensing agreements with seven India-based generic pharmaceutical manufacturers to expand access to its chronic hepatitis C medications in developing countries, including Mongolia.[22]

Screening test costs still remain a barrier, as the screening antibody for HCV and HBsAg costs US$3–5 per test, and one hepatitis B DNA or hepatitis C RNA confirmation test costs US$82–98. Efforts are under way to increase rates of testing with rapid anti-HCV tests.[19] Nonetheless, the main physician-perceived barrier to screening was patient's inability to pay for tests; 25.0%, 24.3%, 30.2% and 37.0% of physicians indicated this barrier for HBV, HCV, HDV and HCC screening, respectively, since the government currently does not subsidise these tests.

Recommendations: Ideally, screening, confirmation and treatment would be universal. However, given the financial constraints, access to testing and treatment should be prioritised according to clinical need, and any preferential access based on other reasons should not be permitted. According to the provider responses, many noted that multiple patient subgroups should be prioritised for HCV and HBV treatment. For example, 27.2% of physicians noted that high-risk patients with cirrhosis, extrahepatic HCV, liver transplant or coexistent liver disease (eg, dual viral infections or viral infection with

Table 3 Physician perceived barriers of hepatitis and hepatocellular carcinoma screening

Perceived barriers to screening	Hepatitis B (%)	Hepatitis C (%)	Hepatitis D (%)	Hepatocellular carcinoma (%)
Asymptomatic disease	10.5	18.6	9.4	8.2
Poor patient awareness and education	13.2	21.4	11.5	20.6
Provider's lack of time and resources	9.2	10.0	2.1	2.7
Lack of screening and management guidelines or awareness of guidelines	15.8	11.4	24.0	17.8
Patients living too far from laboratories and/or clinics	10.5	4.3	12.5	12.3
Lack of access to hepatitis B treatment	10.5	7.1	5.2	1.4
Patient's inability to pay for tests	25.0	24.3	30.2	37.0
Difficulty accessing specialty care	5.3	2.9	5.2	0

another non-viral liver disease) should be prioritised for HCV treatment, while 35.8% of physicians did not think that coexistent liver disease warrants treatment. Given these varying opinions on who should be treated, clear prioritisation guidelines should be developed. Forty-six per cent of physicians also proposed universal screening efforts as a top priority. These screening efforts can identify high-risk patients and would also produce the information necessary to prioritise effectively. Furthermore, when coupled with properly systematic epidemiological surveys, targeted screening efforts can be used to identify sources and modes of virus transmission and design prevention interventions to reduce incidence of new infection. In addition, prioritisation efforts would benefit from systematic capability to identify, characterise and monitor patients with liver disease through an integrated national health information system, such as a patient registry or information module with common standards, terminology and procedures for data entry. HCV-TARGET is an example of a registry initiative, an international consortium of leading HCV investigators who have developed a common research database with standardised data parameters and data acquisition processes.[23] While this database was established to explore the impact of direct acting antiviral agents, a similar relatively low-cost process, consumed by existing information systems in Mongolia, can be employed to develop a patient registry of all patients with viral hepatitis from diagnosis through treatment to understand the extent of disease burden and use a data-driven approach to develop criteria for prioritisation and evaluate outcomes.[23]

The educational barriers included poor patient education and insufficient provider knowledge of treatment. To address poor patient education and awareness, physicians indicated that local fairs (rating of 4.2 out of 5), as well as technology-based solutions (rating of 3.9 out of 5), such as web-based information and mobile educational applications, would improve screening rates.

Recommendation: Given the high rates of mobile phone use, mobile educational applications may be an effective way to disseminate information to larger audiences, especially since adherence to guidelines is low. For example, although there are consensus guidelines in the USA, Europe and Asia for HCC surveillance, the adherence to HCC screening and surveillance is suboptimal.[24–26] These applications would allow clinical guidelines to be disseminated directly to the patient with features such as reminders to encourage better adherence. The patients are then empowered to change the course of their own disease management. In addition, any updates can be easily disseminated through the 'cloud'. In 2014, the four major mobile operators, MobiCom, Unitel, Skytel and G-Mobile, reported more than 4.3 million registered users, which indicates that Mongolian residences own more than one SIM card or mobile phone.[27] Many existing patient education applications can potentially be translated and available to patients in Mongolia. In addition, Facebook and social media platforms can be used to advocate for testing and treatment. From a cultural and social perspective, the physicians noted in another question that they did not see stigma as a barrier to receiving liver disease care in Mongolia, which is a distinct perspective and suggests

Table 4 Physician perceived barriers of hepatitis B and C treatment

Perceived barriers to treatment	Hepatitis B (%)	Hepatitis C (%)
Cost of medication	14.9	25.3
Cost of blood test, medical visits, in addition to cost of medication	10.3	8.4
Active substance abuse	1.2	2.1
Active psychiatric comorbidity	0	0
Patient's fear of side effects	0	0
Lack of consensus about screening and treatment guidelines	5.8	10.5
Lack of provider education about treatment and side effect management	2.3	0
Distance to treating physicians	0	1.1
More than 3 of above	65.5	52.6

Table 5 Physician survey results on priorities for screening and treatment for CHB

Priorities for screening and management	n (%)
Which patients do you think should be screened for hepatitis B infection? (n=64)	
High-risk populations (pregnant women, persons with multiple sex partners, inmates, etc)	32 (50.0)
Older patients (>55 years)	1 (1.6)
All patients	31 (48.4)
Which patients with hepatitis B should be prioritised for treatment? (n=74)	
All patients with compensated or decompensated cirrhosis, regardless of ALT levels, HBeAg status or HBV DNA levels	33 (44.6)
Only patients with decompensated cirrhosis, regardless of ALT levels, HBeAg status or HBV DNA levels	12 (16.2)
Adults with CHB who do not have clinical evidence of cirrhosis, but are older and have highly persistently abnormal ALT levels and evidence of high-level HBV replication, regardless of HBeAg status	24 (32.4)
Patients with persistently abnormal ALT levels alone, regardless of HBeAg status (where HBV DNA testing is not available)	5 (6.8)
Which patients need to be screened for HDV coinfection? (n=86)	
Patients known to be HBsAg positive and symptomatic	37 (43.0)
All patients known to be HBsAg positive, including asymptomatic patients	40 (46.5)
Patients with acute hepatitis B who are not yet HBsAg positive, but are IgM anti-HBc positive	4 (4.7)
Chronic HBV carriers with a history of or active injection drug use	4 (4.7)
No patients should be screened	1 (1.2)

ALT, alanine aminotransferase; anti-HBc, hepatitis B core antibody; CHB, chronic hepatitis B; HBeAg, hepatitis B envelope antigen; HBsAg, hepatitis B surface antigen; HBV, hepatitis B virus; HDV, hepatitis D virus.

higher likelihood of an effective social response to testing and treatment.

Gaps in provider knowledge were confirmed in lower scores on knowledge-based questions about treatment. The mean pretest and post-test scores per physician were 60.4±20.4 and 65.6±21.3 with no observed significant predictors for high baseline knowledge or improvement. This educational symposium was an important step to prepare physicians to treat and manage hepatitis effectively. Physicians remained engaged during the duration of the symposium and improved their knowledge through case studies and lectures. However, future educational efforts are necessary, and the absence of predictors for knowledge and improvement indicate that educational efforts need to be applied broadly. Physicians are eager to learn more, as indicated by the high ratings for future education efforts. The periodic in-person conference such as this symposium was the top preference. The low knowledge of the effect of ribavirin may reflect prior inexperience with interferon-based treatment.

Recommendations: We advocate broad-based, interactive case-based medical education tailored to local needs, based on adequate needs assessment and outcome measurements. Guidelines have also been developed for HCV diagnosis and treatment, and currently are being updated for HBV. The high prevalence of HDV and HCC also warrant an update of these guidelines with a multidisciplinary team of both international and local experts forming an advisory panel to draft these guidelines. Since HDV is a double viral infection, therapy requires consideration and targeting of two viral infections, adding complexity to the management of HDV.[11] These efforts are already underway with the launch of the National Viral Hepatitis Program, which is a comprehensive programme that involves all aspects from prevention to care and disease control to meet a reduction goal for morbidity and mortality due to HBV,

Table 6 Physician survey results on priorities for screening and treatment for chronic hepatitis C

Priorities for screening and management	n (%)
Which patients need to be screened for HCV infection? (n=91)	
A. History of or current injection drug use	3 (3.3)
B. Healthcare workers	1 (1.1)
C. Children born to HCV-infected women	0 (0)
D. Prior recipients of medical procedures, such as transfusions, organ transplants, haemodialysis, surgical procedures	4 (4.4)
E. Patients with unexplained ALT levels	2 (2.2)
F. All patients with A–E	65 (71.4)
G. All older patients	16 (17.6)
Which patients should be prioritised for HCV treatment? (n=81)	
A. Patients with advanced fibrosis or cirrhosis (stages 3–4)	11 (13.6)
B. Patients with cirrhosis	1 (1.2)
C. Liver transplant recipients or patients on immunosuppression for other diseases	1 (1.2)
D. Patients with severe extrahepatic hepatitis C	3 (3.7)
E. Patients with HIV coinfection	2 (2.5)
F. Patients with HBV coinfection	0 (0)
G. Patients with other coexistent liver diseases (eg, NASH)	29 (35.8)
H. All patients A–G	22 (27.2)
I. All patients with chronic HCV regardless of severity	12 (14.8)

ALT, alanine aminotransferase; HBV, hepatitis B virus; HCV, hepatitis C virus; NASH, nonalcoholic steatohepatitis.

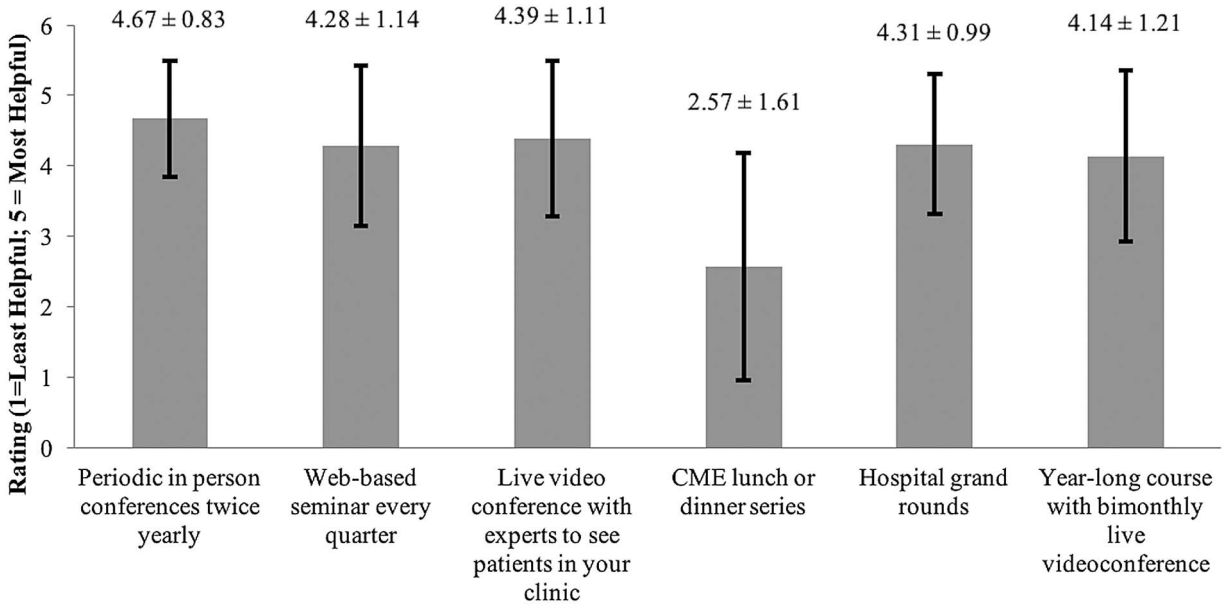

Figure 1 Mean ratings for proposal of future educational programmes to improve provider knowledge (1 as 'least useful' to 5 as 'most useful'). CME, Continuing Medical Education.

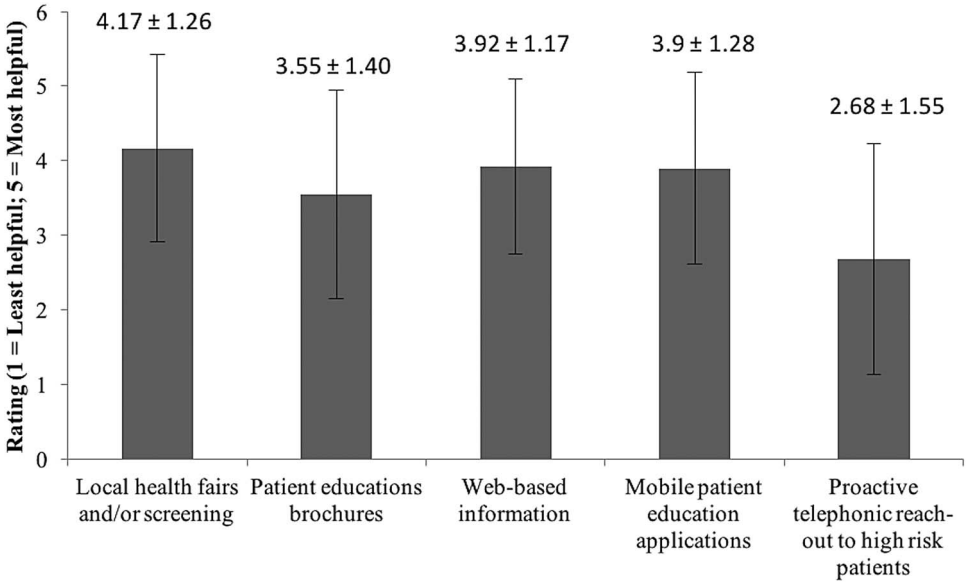

Figure 2 Mean ratings for proposal of future efforts to improve screening (1 as 'least useful' to 5 as 'most useful').

HDV and HCV. The MOHS also provides strong support on HBV and HDV clinical guideline development and HCV guideline updates.[28] Other existing regional guidelines for HBV reflect significant regional variation, and new guidelines relevant to the needs of Mongolian patients are essential since application to Mongolia depends on resource infrastructure and differences in local epidemiology.[29–34] Education of providers can be addressed by remote educational programmes such as Project ECHO (Extension for Community Healthcare Outcomes), which can provide access to specialty care and consultation for patients and physicians in smaller cities as well as international hepatologists to serve as mentors and colleagues for hepatologists in Mongolia. Training also includes case-based learning, didactic presentations, case consultations and videoconferences. One study found that the quality of hepatitis C care provided by ECHO-trained primary care providers was equivalent to care provided by university-based specialists.[35] Lessons from HIV management in other developing countries also suggest the need to disseminate knowledge to other providers besides physicians, such as community health workers, to lessen the burden on providers and expand access to care to all patients. Project ECHO can be used to train other types of providers as well.[36–38]

Finally, this type of provider needs assessment of both knowledge and their perceptions is necessary to understand the educational efforts that would resonate with providers in the local community. Local and country-specific disease knowledge is important, because there may be unique disease determinants or distribution. In Mongolia, the prevalence of HBV/HDV coinfection is very high (over 10% compared with <5% in most other endemic areas in the world) and is known to associate with more rapid disease progression.[10–12] Among HCV-infected persons, almost all (98%) have genotype 1b and two-third demonstrated Q80k polymorphism, both of which can have implication in regard to response to antiviral therapy.[39 40] Overall, there is much heterogeneity for HCV among Asians depending on local epidemiology and even coinfection dominance of HCV/HBV differs by ethnicity, which may also contribute to potential differences in disease progression and treatment response.[41 42] Furthermore, there are known differences in survival for patients with HCC depending on ethnic heterogeneity, reiterating the importance of understanding local patterns of disease.[43–46] Regarding physician perception, this can be influenced by the obvious cultural and patient population differences which are usually addressed and considered, but the influence by provider variations is also very important but often overlooked. Mongolia is an example of a unique physician demographic with 86.9% female, 38.8% practising in rural areas and having limited experience with managing antiviral treatment. In contrast, a neighbouring country, China, has 55.3% male physicians.[47] Mongolia's educational needs will most likely be very different from those of other developing countries and will evolve over time as exposure to treatment management increases. As such, this type of needs assessment should be periodically conducted to meet the evolving educational needs.

Limitations of this study include the subjective nature of the surveys, which may lead to overestimates in practice pattern questions, although the survey methodology allowed for perceptions to be accurately captured. Another limitation is that all of the attendees were physicians and other types of providers were not present. Most physicians were also specialists and university affiliated. However, the physicians come from all major provinces and represent a diverse geographic sample out of a total of ~8500 physicians of all specialties serving a population of close to 3 million people.[3] The first step should be to educate specialists and physicians, but expansion and task shifting to other providers is necessary for more efficient and broader access to care. Nevertheless, the study surveyed physicians from diverse geographic regions of Mongolia and the survey also had a high response rate with 74.1% of questions responded to by at least 50–75% of participants.

In conclusion, physicians from all major regions of Mongolia highlighted the need to remove financial barriers to screening for viral hepatitis and increase access to safe and effective treatment through well-designed and targeted patient and provider educational efforts. Our observations reveal that there are abundant opportunities in Mongolia to strengthen health service delivery for people living with viral hepatitis and liver disease. There is a youthful, energetic, motivated medical community and government who are committed to expanding capacity for clinical services. The survey has exposed requirements needed for a successful scale-up of these services such as removal of financial constraints to testing and treatment, and advancing patient and provider education, which can be achievable using more innovative digital health approaches. Innovative approaches to broad-based screening, low-cost diagnostics and medical education, advocacy and patient outreach, especially using some newer forms of digital technologies, can be expected to have a significant impact on the public health of Mongolia. Beyond Mongolia, this work outlines a process and provider survey methodology that can be applied to other developing countries in order to understand local needs and develop targeted recommendations for educational and organisational approaches to expand care.

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REFERENCES

1. Stanaway JD, Flaxman AD, Naghavi M, *et al*. Global burden of viral hepatitis from 1990 to 2013. Findings from the Global Burden of Disease Study 2013. *Lancet* 2016;388:1081–8.
2. http://www.wcrf.org/int/cancer-facts-figures/data-specific-cancers/liver-cancer-statistics (accessed 15 Oct 2015).
3. https://www.cia.gov/library/publications/the-world-factbook/geos/mg.html (accessed 3 Jun 2016).
4. Sandagdorj T, Sanjaajamts E, Tudev U, *et al*. Cancer incidence and mortality in Mongolia—National Registry Data. *Asian Pac J Cancer Prev* 2010;11:1509–14.
5. Jazag A, Puntsagdulam N, Chinburen J. Status quo of chronic liver diseases, including hepatocellular carcinoma, in Mongolia. *Korean J Intern Med* 2012;27:121–7.
6. http://www.chd.mohs.mn/images/pdf/sma/2015/eruul_mendiin_uzuulelt_2014_angli_1.pdf (accessed 25 Jun 2016).
7. Baatarkhuu O, Kim do Y, Nymadawa P, *et al*. Clinical features and prognosis of hepatocellular carcinoma in Mongolia: a multicenter study. *Hepatol Int* 2012;6:763–9.
8. http://www.wpro.who.int/mongolia/mediacentre/hepatitis_b_control/en/ (accessed 3 Jun 2016).
9. Pan CQ, Duan Z, Dai E, *et al*. Tenofovir to prevent hepatitis B transmission in mothers with high viral load. *N Engl J Med* 2016;374:2324–34.
10. Davaalkham D, Ojima T, Uehara R, *et al*. Hepatitis delta virus infection in Mongolia: analyses of geographic distribution, risk factors, and disease severity. *Am J Trop Med Hyg* 2006;75:365–9.
11. Heidrich B, Manns MP, Wedemeyer H. Treatment options for hepatitis delta virus infection. *Curr Infect Dis Rep* 2013;15:31–8.
12. Hughes SA, Wedemeyer H, Harrison PM. Hepatitis delta virus. *Lancet* 2011;378:73–85.
13. Tsatsralt-Od B, Takahashi M, Nishizawa T, *et al*. High prevalence of dual or triple infection of hepatitis B, C, and delta viruses among patients with chronic liver disease in Mongolia. *J Med Virol* 2005;77:491–9.
14. Dondog B, Lise M, Dondov O, *et al*. Hepatitis B and C virus infections in hepatocellular carcinoma and cirrhosis in Mongolia. *Eur J Cancer Prev* 2011;20:33–9.
15. Kurbanov F, Tanaka Y, Elkady A, *et al*. Tracing hepatitis C and delta viruses to estimate their contribution in HCC rates in Mongolia. *J Viral Hepat* 2007;14:667–74.
16. Oyunsuren T, Kurbanov F, Tanaka Y, *et al*. High frequency of hepatocellular carcinoma in Mongolia; association with mono-, or co-infection with hepatitis C, B, and delta viruses. *J Med Virol* 2006;78:1688–95.
17. Oyunsuren T, Sanduijav R, Davaadorj D, *et al*. Hepatocellular carcinoma and its early detection by AFP testing in Mongolia. *Asian Pac J Cancer Prev* 2006;7:460–2.
18. Jazag A, Puntsagdulam N. Demography and mortality of patients undergone liver resection due to HCC at National Cancer Center in Mongolia. APASL 2nd Hepatocellular Carcinoma Conference; Jeju, Korea, 1–3 December 2011.
19. http://www.wpro.who.int/hepatitis/resource/features/mongolia_story/en/ (accessed 3 Jun 2016).
20. https://www.nvtg.org/userfiles/files/Wilbert_Bannenberg_NVTG_16_October_2015.pdf (accessed 3 Mar 2016).
21. Lim SG, Amarapurkar DN, Chan LY, *et al*. Reimbursement policies in the Asia Pacific for chronic hepatitis B. *Hepatol Int* 2015;9:43–51.
22. http://www.gilead.com/news/press-releases/2014/9/gilead-announces-generic-licensing-agreements-to-increase-access-to-hepatitis-c-treatments-in-developing-countries#sthash.5ibioMve.dpuf (accessed 3 Jun 2016).
23. http://www.hcvtarget.org/index.php/about-us/hcv-target-and-the-ctsa (accessed 3 Jun 2016).
24. Zhao C, Nguyen MH. Hepatocellular carcinoma screening and surveillance: guidelines and real-life practice. *J Clin Gastroenterol* 2016;50:120–33.
25. Zhao C, Jin M, Le RH, *et al*. Regional and etiological differences in the adherence to hepatocellular carcinoma (HCC) surveillance among patients of chronic hepatitis B (CHB) and cirrhosis of all etiologies: a meta-analysis of 15,429 patients from 14 individual studies. *Hepatology* 2015;62:S440–1.
26. Jin MQ, Le RH, Jin M, *et al*. Meta-analysis: proportions of hepatocellular carcinoma (HCC) diagnosed by screening, surveillance, or without symptoms is dismally low across different world regions and underlying liver diseases. *Hepatology* 2015;62:S396.
27. http://www.oxfordbusinessgroup.com/overview/rapid-mobile-phone-uptake-recent-years-has-set-scene-growth-data-services-mongolias-telecoms-sector (accessed 3 Jun 2016).
28. http://legalinfo.mn/law/details/11663?lawid=11663 (accessed 24 Jun 2016).
29. Uribe LA, O'Brien CG, Wong RJ, *et al*. Current treatment guidelines for chronic hepatitis B and their applications: a systematic review. *J Clin Gastroenterol* 2014;48:773–83.
30. Terrault NA, Bzowej NH, Chang KM, *et al*, American Association for the Study of Liver Diseases. AASLD guidelines for treatment of chronic hepatitis B. *Hepatology* 2016;63:261–83.
31. Sarin SK, Kumar M, Lau GK, *et al*. Asian-Pacific clinical practice guidelines on the management of hepatitis B: a 2015 update. *Hepatol Int* 2016;10:1–98.
32. http://www.who.int/hiv/pub/hepatitis/hepatitis-b-guidelines/en/ (accessed 25 Jun 2015).
33. European Association for the Study of the Liver. EASL clinical practice guidelines: management of chronic hepatitis B virus infection. *J Hepatol* 2012;57:167–85.
34. Martin P, Lau Daryl TY, Nguyen MH, *et al*. A treatment algorithm for the management of chronic hepatitis B virus infection in the United States: 2015 Update. *Clin Gastroentrol Hepatol* 2015;13:2071–87.
35. Arora S, Thornton K, Murata G, *et al*. Outcomes of treatment for hepatitis C virus infection by primary care providers. *N Engl J Med* 2011;364:2199–207.
36. Jayasekera CR, Barry M, Roberts LR, *et al*. Treating hepatitis C in lower-income countries. *N Engl J Med* 2014;370:1869–71.
37. Singh P, Chokshi DA. Community health workers—a local solution to a global problem. *N Engl J Med* 2013;369:894–6.
38. Farmer PE. Shattuck lecture. Chronic infectious diseases and the future of health care delivery. *New Engl J Med* 2013;369:2424–6.
39. Nymadawa P, Byambasukh D, Oyunsuvd CH, *et al*. To the study of the prevalence of HCV genotypes and Q80K polymorphism in Ulaanbaatar, Mongolia. *Onosh (Diagnosis)* 2016;5:127.
40. Coppola N, Minichini C, Starace M, *et al*. Clinical impact of the hepatitis C virus mutations in the era of directly acting antivirals. *J Med Virol* 2016;88:1659–71.
41. Nguyen LH, Nguyen MH. Systematic review: Asian patients with chronic hepatitis C infection. *Aliment Pharmacol Ther* 2013;37:921–36.
42. Nguyen LH, Ko S, Wong S, *et al*. Ethnic differences in viral dominance patterns in patients with dual infection with hepatitis B virus and hepatitis C virus. *Hepatology* 2011;53:1839–45.
43. El-Serag HB. Hepatocellular carcinoma. *N Engl J Med* 2011;365:1118–27.
44. Kutsenko A, Ladenheim M, Kim N, *et al*. Heterogeneity among Asian American with hepatocellular carcinoma (HCC). *Gastroenterology* 2016;140:S1136.
45. Yip B, Wantuck JM, Kim LH, *et al*. Clinical presentation and survival of Asian and non-Asian patients with HCV-related hepatocellular carcinoma. *Dig Dis Sci* 2014;59:192–200.
46. Asselah T, Boyer N, Saadoun D, *et al*. Direct-acting antivirals for the treatment of hepatitis C virus infection: optimizing current IFN-free treatment and future perspectives. *Liver Int* 2016;36:47–57.
47. http://www.ephmra.org/user_uploads/dr%20stats%20asia%20report%20final(1).pdf (accessed 15 Jun 2016).