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The Price Tag of a Potential Cure for Chronic Hepatitis B Infection: A Cost Threshold Analysis for USA, China, and Australia

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List of abbreviations

CHB: Chronic hepatitis B

HCC: Hepatocellular carcinoma

HCV: Hepatitis C virus

DAAs: Direct acting antivirals

PBAC: Pharmaceutical benefits advisory committee

PBS: Pharmaceutical benefits scheme

QALYs: Quality adjusted life years

ETV: Entecavir

TDF: Tenofovir

GDP: Gross domestic product

RMB: Chinese yuan

WAC: Wholesale acquisition cost

SARS-COV-2: Severe acute respiratory syndrome coronavirus 2

Abstract

Background & Aims: We aim to capture the economic impact of a potential cure for chronic hepatitis B infection (CHB) in three countries (USA, China, and Australia) with different health systems and epidemics to estimate the threshold drug prices below which a CHB cure would be cost-saving and/or highly cost-effective. **Methods**: We simulated patients' hepatitis B progression, under three scenarios: current long-term suppressive antiviral therapy, functional cure defined as sustained undetectable HBsAg and HBV DNA, and partial cure defined as sustained undetectable HBV DNA only after a finite, 48-week treatment. **Results**: Compared with current long-term antiviral therapy, a 30% effective functional cure among patients with and without cirrhosis in the USA, China and Australia would yield 17.50, 17.32 and 20.42 QALYs per patient, and 20.61, 20.42 and 20.62 QALYs, respectively. In financial terms, for CHB patients with and without cirrhosis, this would be cost-saving at a one-time treatment cost under

US$11,944 and US$6,694 respectively in the USA, US$1,744 and US$1,001 in China, and US$12,063 and US$10,983 in Australia. **Conclusion**: We show that in purely economic tems, a CHB cure will be highly cost-effective even if effective in only 30% of treated patients. The threshold price for cure is largely determined by the current antiviral drug costs, since it will replace a daily antiviral pill that is inexpensive and effective, although not curative. The likely need for combination therapies to achieve cure will also present cost challenges. While cost-effectivenss is important, it cannot be the only consideration, as cure will provide many benefits additional to reduced liver diease and HCC, including eliminating the need for a long term daily pill and reducing stigma often associated with chronic viral infection.

Key words: HBV cure, antiviral therapy, cost-effectiveness, affordability, access

Lay summary

Hepatitis B virus can lead to a life-long infection known as chronic hepatitis B, which is a major cause of death due to liver disease and liver cancer. There are currently large efforts in finding a cure for the Hepatitis B virus infection. In order for the cure to be affordable and cost-saving for the population, in this paper, we estimate the cost of a potential cure.

Introduction

There were an estimated 296 million people living with chronic hepatitis B (CHB) globally in 2015 [1]. Around 64 million (25%) will need antiviral treatment according to the current treatment guidelines [2, 3]. Indication for treatment is based on evidence of liver damage (cirrhosis or elevation in ALT levels) and viral load (HBV DNA level). The goal of antiviral therapy for CHB is to improve quality of life and survival by preventing progression of the disease to cirrhosis, decompensated cirrhosis, hepatocellular carcinoma (HCC), and death. Antiviral treatment with highly effective and low resistance first line medication (entecavir or tenofovir), as simple as taking a pill a day, allows continued viral suppression, prevents disease progression and reduces the risk of liver cancer. However, current treatment is not curative and even with ongoing treatment, people remain at risk for developing liver cancer and require long-term monitoring including liver ultrasound every 6 months [3]. The cure for hepatitis C virus infection (HCV) and HBV research advances have raised hope for a potential HBV cure. The initial very high price for oral direct acting antivirals (DAAs) for HCV has led to a debate about the value and affordability of HCV treatment in the US and in most high and middle income countries resulting in a lack of treatment access for many people who would otherwise be cured [4]. These DAAs for HCV are still so expensive in many settings that despite their benefits for patients, they can be budget busters for governmental programs and insurance carriers [5]. Meanwhile, encouraging developments are happening towards finding a cure for HBV within academic research centers and the industry. There are currently around 47 drugs, including direct acting antivirals and also indirect agents that drive the immune system to attack the HBV virus, which are being evaluated in preclinical models or are in the first phases of clinical development [6].
The hepatitis B epidemic varies globally. It is likely that the costs and benefits of a potential CHB cure would differ between countries. High-income countries may be more able to pay high prices, but the prevalence is often modest. Even within high-income countries, there are variations in health systems, procurement and payment arrangements, and drug prices. Some low

and middle income countries (LMICs) may have higher prevalence but a lower ability to pay for curative regimens. We have chosen to focus on the United States (USA), China, and Australia. The USA has the highest health spending of any country and routinely has the highest prices for drugs [7]. Unlike the United States, which has few mechanisms to control pharmaceutical prices, Australia has the Pharmaceutical Benefits Advisory Committee (PBAC) that makes recommendations for medicines to be listed in the national Pharmaceutical Benefits Scheme (PBS) based on their cost-effectiveness [8]. Interestingly in the case of current HBV treatment costs Australia has higher cost for generic antiviral therapies. China has the highest burden of CHB in the world, and has relatively low drug prices. The aim of this study is to capture the economic impact of a potential functional cure for CHB in these three countries with varying health systems and epidemics to estimate the threshold drug prices below which a CHB cure would be cost-saving and/or highly cost-effective.

Materials and Methods

Overview

Using a Markov model (Supplement Figure 1), we simulated patients' progression through a discrete series of health states, comparing a potential functional and potential partial cure to current practice with long-term ETV or TDF antiviral therapy. Outcomes from the model included lifetime treatment costs, monitoring and medical management costs, and quality-adjusted life-years (QALYs) and risk of clinical endpoints (cirrhosis, decompensated cirrhosis, HCC, CHB related mortality). From these per-person results, we were able to calculate population-level outcomes and drug cost thresholds for cure in order for it to be considered cost-saving or cost-effective. Overall estimates were calculated by combining sex-specific results into weighted averages with a male to female ratio of 60:40 [9]. We assumed an age of 45, but varied this in sensitivity analysis.

Scenarios

The following scenarios (see Table 1 for scenario outline) were evaluated:

Current long-term antiviral therapy scenario: In this scenario, we assumed that everyone who is eligible for treatment according to the current treatment guidelines [2, 10] will receive lifetime treatment with current first line therapy (generic ETV or TDF) with full adherence to therapy.

Although rare, treatment can be stopped after HBsAg loss [11], and in the model we assume that treatment will be stopped for those without cirrhosis after HBsAg loss. We assumed that entecavir and tenofovir had similar efficacy and cost. We assumed that monitoring (blood tests for HBV DNA and ALT) would occur twice yearly, and HCC surveillance consisting of liver ultrasound every 6 months for those with cirrhosis would be implemented.

Partial cure scenario: Partial cure is defined as "detectable HBsAg but persistently undetectable HBV DNA in serum after completion of a finite 12-month course of treatment" [12].

Functional cure scenario: Functional cure is defined as as "sustained, undetectable HBsAg and HBV DNA in serum with or without (anti-HBs) seroconversion after completion of a finite 12-month course of treatment, resolution of residual liver injury and a decrease in risk of HCC over time" [12].

In the first year (during initial treatment (pre-cure)), we assumed that patients who subsequently achieved partial or functional cure will receive monitoring twice a year for HBV DNA, ALT and abdominal ultrasound. We assumed in patients who have achieved a partial cure, monitoring with blood tests for HBV DNA and ALT will drop to once a year, and abdominal ultrasound will continue once a year in patients without cirrhosis and twice a year in patients with cirrhosis. We assume in patients who achieved a functional cure, they will not require further HBV DNA and ALT monitoring tests, and only the patients with cirrhosis required abdominal ultrasound twice a year. All scenarios assumed the starting treatment eligibility are adults with cirrhosis or adults with high viral load and high ALT levels, according to current treatment guidelines [2, 10]. We assume the partial cure and functional cure are 30% effective after the 12-month treatment, and the remaining 70% who did not achieve 'cure" would continue on indefinite long-term antiviral therapy with ETV or TDF, with a probability of having viral suppression.

Model

A Markov model was developed using TreeAge Pro 2019 to simulate long-term outcomes, including cirrhosis, decompensated cirrhosis, HCC, and HBV-related death. Treatment-related age- (where available) and gender-specific state transition estimates were calculated in one-year cycles. Females were estimated to have 50% lower rates of disease progression based on recent studies [9, 13, 14]. Causes of death that were not related to CHB were included in the model, based on age- and gender-specific mortality rates from country-specific life tables [15-17] (Supplement

Table 1). We compared the costs and QALYs from a hypothetical potential cure to current antiviral treatment. We calculated drug costs thresholds for a cure that is cost-saving, or highly cost-effective.

We used generic antiviral drug costs for ETV and TDF from each country [8, 18, 19] for the base case analysis and examined a range of antiviral drug costs in the sensitivity analysis (Supplement Table 2). We used country specific utilities [20] which are shown in supplement Table 3. Based on the last HBV endpoint conference in 2019 [12], a functional cure rate of >30% after 1 year therapy was suggested as a desired response rate for phase III trials. We assumed the cure would be 30% effective in our base case and tested cure rates of 10%, 50% and 90% in sensitivity analysis. Following the World Health Organization guidelines for cost-effectiveness estimates [21], we defined highly cost-effective as paying 1x or less than 1x per-capita gross domestic product (GDP) for each QALY gained, using US$62,517, US$9,633, and US$56,698, as the per-capita GDP (2019) for USA, China, and Australia, respectively [22]. We reported the outcomes in US dollars for each country, as well as in Chinese yuan (RMB) and Australian dollars (Supplement Table 2).

Sensitivity Analysis

We examined 10%, 50% and 90% effectiveness for both functional and partial cures. Since a cure is compared to current long-term antiviral therapy, the cost of current first line antiviral (entecavir or tenofovir) treatment can have an important impact in determining how valuable a cure would be. Given that the cost of current antiviral treatment has dropped dramatically in recent years as entecavir and tenofovir have come off patent, we also varied the costs of current antiviral therapy in different countries. We varied the annual cost of current antiviral therapy down to US$10 dollars per year in China [23] and we lowered the cost of current antiviral therapy by 50% to US$618 per year in Australia. We ran a separate analysis to look at the benefit that inactive carriers might achieve from a curative treatment. We compared treating those with inactive disease vs. waiting until activation (becoming treatment eligible according to the treatment guidelines) and then giving either long-term therapy or curative therapy. One-way sensitivity analyses were conducted to look at the impact of all parameters on the threshold price in the USA, China and Australia. Tornado diagrams were produced to illustrate the relative impact of each parameter on the threshold price.

Results

In the USA, treatment that results in a partial cure and functional cure will yield 17.14 and 17.50 QALYs per patient among those with cirrhosis, and 20.57 and 20.61 among those without cirrhosis, respectively. The health impact outcomes related to all scenarios are shown in supplement Table 4. For both groups, the treatment costs are dramatically reduced because most patients will not require long-term treatment. Most of the costs saved from a cure are in the costs of monitoring and treatment for those without cirrhosis but for those with cirrhosis, most of the cost savings are from reduced disease management costs (Table 2 and Figure 1A). A partial cure needs to cost no greater than US$7,759 to be cost-saving and no greater than US$20,180 to be highly cost-effective among those with cirrhosis, and no greater than US$3,990 to be cost-saving and no greater than US$6,776 to be highly cost-effective among those without cirrhosis. A functional cure needs to cost no greater than US$11,944 to be cost-saving and no greater than US$47,166 to be highly cost-effective among those with cirrhosis, and no greater than US$6,694 to be cost-saving and no greater than US$11,705 to be highly cost-effective among those without cirrhosis (Figure 2A).

In China, treatment that results in a partial cure and functional cure will yield 16.95 and 17.32 QALYs per patient among those with cirrhosis, and 20.39 and 20.42 among those without cirrhosis, respectively. Most of the costs saved from a cure are in the costs of monitoring and treatment for those without cirrhosis but for those with cirrhosis, most of the cost savings are from reduced disease management costs (Table 2 and Figure 1B). A partial cure needs to cost no greater than US$977 to be cost-saving and needs to cost no greater than US$3,079 to be highly cost-effective among those with cirrhosis, and no greater than US$540 to be cost-saving and no greater than US$1,052 to be highly cost-effective among those without cirrhosis. A functional cure needs to cost no greater than US$1,744 to be cost-saving and no greater than US$7,381 to be highly cost-effective among those with cirrhosis, and no greater than US$1,001 to be cost-saving and no greater than US$1,861 to be highly cost-effective among those without cirrhosis (Figure 2B).

In Australia, treatment that results in a partial cure and functional cure will yield 17.15 and 17.51 QALYs per patient among those with cirrhosis, and 20.59 and 20.62 among those without cirrhosis, respectively. Most of the costs saved from a cure are in the costs of long-term antiviral treatment in patients with and without cirrhosis because of the current high drug prices in Australia for ETV and TDF (Table 2 and Figure 1C). A partial cure needs to cost no greater than US$9,739 to be cost-saving and no greater than US$21,069 to be highly cost-effective among those with cirrhosis, and no greater than US$7,863 to be cost-saving and no greater than US$10,298 to be highly cost-effective among those without cirrhosis. A functional cure needs to cost no greater than US$12,063 to be cost-saving and no greater than US$44,017 to be highly cost-effective among those with cirrhosis, and no greater than US$10,983 to be cost-saving and no greater than US$15,422 to be highly cost-effective among those without cirrhosis (Figure 2C).

Sensitivity analysis

The results for what the curative drug needs to cost if it was 10%, 50%, or 90% effective are shown in supplement Figures 2-4. If the cure is less effective, then the drug would have to cost less in order to be considered cost-effective. For example, in the United States, a functional cure with 10% effectiveness would have to cost less than US$5,888 for those without cirrhosis or cost less than US$19,394 for those with cirrhosis to be considered highly cost-effective (supplement Figure 4a).

If current antiviral therapy were to cost US$10 per year in China, the overall cost per patient in a lifetime would be US$8,748 in patients with cirrhosis and US$3,165 in patients without cirrhosis. This then affects the potential cost a cure must have in order to be considered valuable. For a partial cure, the drug will need to cost less than US$389 for it to be cost-saving in patients without cirrhosis, and US$818 in patients with cirrhsosis. For it to be highly cost-effective, the partial cure needs to cost less than US$900 in patients without cirrhosis, and US$2,920 in patients with cirrhosis. For a functional cure, the treatment will need to cost less than US$849 and US$1,591 for it to be cost-saving and less than US$1,709 and US$7,228 for it to be highly cost-effective, in patients without and with cirrhosis, respectively (supplement Figure 5). If first line antiviral cost in Australia were to drop by 50% to US$618 per year, the current antiviral therapy overall cost per patient in a lifetime would be US$36,844 in patients with cirrhosis and

US$23,536 without cirrhosis. With this drop, the partial cure will need to cost less than US$4,259 and US$5,925 for it to be cost-saving, and less than US$6,694 and US$17,254 for it to be highly cost-effective, in patients without and with cirrhosis, respectively. For functional cure, the treatment will need to cost less than US$7,363 and US$8,398 for it to be cost-saving, and US$11,802 and US$40,352 for it to be highly cost-effective, in patients without or with cirrhosis, respectively (supplement Figure 6).

One-way sensitivity analyses conducted by varying each parameter individually showed that the cost of current antiviral therapy and the health-related quality-of-life associated with viral suppression were the most important parameters driving the threshold price for cost-effectiveness of a cure (supplement Figures 7-8). For example, if the cost associated with current antiviral therapy is very high, there is additional value in having a cure, which would still be considered cost-effective even at substantially higher prices.

Finally it may be cost-effective to immediately provide a partial or functional cure to those with inactive disease (supplement Tables 5 and 6) instead of the current practice of monitoring and waiting for active disease to develop before treating with currently-available antivirals. A functional cure will need to cost less than US$3,699 in order for immediate treatment with a cure to be cost-saving compared to the current practice of waiting and providing long term antiviral treatment (supplement Figure 9). If we had a functional cure, immediate treating of inactive patients with the functional cure would be save US$3,195 compared to waiting until they activate disease before providing the functional cure (supplement Figure 10).

Discussion

If the treatment that results in a functional cure is 30% effective, the price tag for the new drug needs to be no greater than US$11,944 and US$6,694 in the USA, US$1,744 and US$1,001 in China, and US$12,063 and US$10,983 in Australia, for it to be cost-saving compared to current antiviral therapy, among those with and without cirrhosis, respectively. Ideally, cure rates would be higher than 30%, but in the short-to-medium term it is likely that they will start low and increase incrementally, from the current low of 1-2% per year that is achieved using direct acting antiviral therapy. Because a cure would be replacing an inexpensive daily antiviral pill that effectively controls HBV replications, the threshold price for a cure cost is highly determined by

the current antiviral drug costs and the effectiveness rate of the cure. If current antiviral drug costs were to drop further, the cure cost will also have to drop for it to be cost-saving or highly cost-effective in the population. However, a finite cure will offer the added benefit of HBsAg loss, which will further reduce HCC risk, eliminate the need for a daily pill, and furthermore help overcome the stigma of living with chronic HBV infection. Because the current costs of ETV and TDF are high in Australia (compared to USA and China), a functional cure will save more money in treatment costs compared with current long-term antiviral therapy, and since patients without cirrhosis are likely to live longer than those with cirrhosis, the dollars saved are much higher for patients without cirrhosis.

In the United States, pharmaceutical companies determine the published list price of the medication, which is the wholesale acquisition cost (WAC). The company negotiates contracts with other organizations within the pharmaceutical supply chain that allow for rebates or discounts to decrease the actual price paid [24]. Except for mandated rebates, negotiated drug prices are considered confidential business contracts. Therefore, there is almost no transparency regarding the actual prices paid for drugs [25]. The DAA medications for HCV are among the most expensive oral medications in history, with WAC prices ranging from US$417 to US$1,125 per day [26]. However, many payers are paying below the WAC for HCV cure medications, since the average negotiated discount of 22% in 2014 increased to 46% less than the WAC in 2015 [27].
The model used for this study was based on a Markov model of disease progression and did not incorporate disease transmission effects. Not including transmission effects could potentially underestimate the value of a highly-effective cure, but given high prevalence of infant hepatitis B vaccination in these countries for many years it is unlikely the omission of transmission effects is a substantial source of bias (as childhood infections are those most likely to progress to chronic infection).
The cost of first-line treatment in Australia is much higher than in most countries. Both entecavir and tenofovir are heavily subsidized by the government, being listed in the Pharmaceutical Benefits Scheme (PBS). While patients pay less than AU$40 per month for these medications (less than AU$10 per month concessional), the PBS pays much more for these medications, despite generic versions being available. This is an artefact of the negotiated lower prices at time of listing not being reflected in rapid price drops being realized following medications coming

off patent, with prices paid by the PBS being expected to remain high for some years after patent expiry.

One important limitation is the assumption of full adherence to current antiviral treatment, which is not always achieved in real life. Current estimates of adherence of patients receiving antivirals for CHB ranges from 67% to 80% [28-30]. Given a major advantage of curative therapies is a finite period of treatment, the impact of assuming full adherence to current antiviral therapy underestimates the relative benefit of the time limited curative therapies simulated in this study. Furthermore, current antiviral treatment requires investment and adherence to long-term monitoring with blood tests and ultrasound which has been reported to be as low as 35% [31]. Again, it is assumed in this study that ongoing monitoring in those receiving current antiviral treatment occurs in all patients. Another limitation is that we have not factored in costs associated with patients who require immunosuppressive therapy and would require HBV DNA testing [32]. We did not consider modelling complete sterilizing cure with undetectable HBsAg in serum and eradication of HBV DNA including intrahepatic cccDNA and integrated HBV DNA. A complete sterilizing cure is yet to be observed naturally in any individuals living with CHB, nor in individuals who have recovered from transient acute HBV infection, and seems unlikely to be achievable therapeutically in the short term [33].

A key concern regarding access to DAAs for HCV has been that of equity, with a lack of access in many countries where the burden of HCV infection is greatest. This problem could be just as significant for CHB, where the vast majority of the 296 million people affected are living in LMICs, many of which lack universal health coverage [34]. Even where national health systems are present, many have struggled to include HCV DAAs due to the real or perceived impact this could have on available budgets. This challenge must be addressed early-on to allow future CHB cures to have the greatest possible impact, as equitably as possible, in the time of economic benefits of investing in the elimination of hepatitis B [35].

There is an ongoing discussion regarding assessment of eligibility criteria for antiviral treatment for CHB, and the potential need to re-evaluate the patient population who could benefit from treatment or indeed cure [36]. In this study, we assumed patients would be treated according to current guidelines for eligibility. If there were to be a functional cure, it is plausible that guidelines for eligibility for this cure may change. If the price were higher than the population-average results mentioned above, a cure could still be cost-saving or highly cost-effective for a

subpopulation facing a higher lifetime risk of adverse HBV-related outcomes: younger populations and those with cirrhosis. In the US, some insurers have implemented cost containment strategies to prevent early stage patients from receiving curative HCV therapy. However, lawsuits have been filed concerning the ethics of this type of practice [37]. Alternative pricing mechanisms such as lump-sum remuneration – the so called subscription or 'Netflix' model – have resulted in much cheaper costs to governments including in Australia [38] which has allowed very extensive access to these medications, with no restriction by level of fibrosis, prescriber type (specialist or general practitioner), current injecting status, imprisonment, or whether previously treated and re-infected. Such mechanisms are arguably far more ethical than restricting access to potentially life-saving treatments, while still delivering substantial (and guaranteed) financial benefits to suppliers.

Health systems, clinicians and the global community are currently experiencing a profound challenge in the form of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic [39]. The direct mortality attributable to this recently emerged pathogen is substantial [40]. However even in the setting of substantial epidemics with high case fatality rates – such as the 2014-2015 Ebola outbreak in West Africa – more deaths are estimated to have resulted from the impact of disruption to malaria programs alone than directly caused by Ebola itself [41]. The same concern applies to hepatitis B treatment and care programs in the current pandemic; in China, where SARS-CoV-2 was first reported, 4,643 deaths due to this emergent virus were reported by 30 April 2020 [42]; in a comparable four month period in 2017, over 100,000 people in China were estimated to have died due to hepatitis B-related liver cancer and cirrhosis [43].

Overall, a CHB cure would be valuable even though a low-cost, highly-effective treatment exists. The precise threshold at which the cure is cost-saving and/or highly cost-effective depends on the efficacy, the population treated, and the country in which the therapy is given. The cure would be a substitute for life-long medication, and likely also reduce stigma associated with living with chronic viral infection. While the current existing scientific efforts to develop cures for CHB continue to accelerate, it is essential that the global community learn the lessons of previous inequitable access to life saving treatments, and develop financing mechanisms that support innovation and drug development without setting cure prices out of reach of the vast majority of people living with CHB worldwide.

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Table 1. Scenario outline

Scenario	**Treatment**	**Treatment duration**	**Starting eligibility**	**Effectiveness**	**Monitoring**	**Annual Costs**
Current Antiviral Therapy	Conventional first line antiviral therapy (ETV or TDF)	Indefinite (stop treatment when HBsAg loss is achieved among those without cirrhosis)	Cirrhosis or Without cirrhosis (elevated ALT and HBV DNA)	Viral Suppression, HBsAg loss	Monitoring HBV DNA and ALT levels twice yearly, liver ultrasound twice yearly for cirrhosis	*Lowest cost generic antiviral ETV or TDF: US$326 (USA), US$36 (China), US$1236 Australia *Monitoring: US$267 (USA) US$42 (China) US$284 (Australia) *Liver ultrasound: US$125 (USA) US$19 (China) US$258 (Australia)
Partial Cure	Cure (new hypothetical drug)	48 weeks	Cirrhosis or Without cirrhosis (elevated ALT and HBV DNA)	Detectable HBsAg but persistently undetectable HBV DNA in serum	* Monitoring HBV DNA and ALT levels and liver ultrasound once yearly for patients without cirrhosis * Monitoring HBV DNA and ALT levels once yearly; liver ultrasound once yearly for patients with cirrhosis	* Cure drug costs: depending on cost-saving or cost-effectiveness threshold * Monitoring: US$133 (USA) US$21 (China) US$142 (Australia) *Liver ultrasound: US$125 (USA) US$19 (China) US$258

Functional Cure	Cure (new hypothetical drug)	48 weeks	Cirrhosis or Without cirrhosis (elevated ALT and HBV DNA)	Sustained undetectable HBsAg and HBV in serum with or without anti-HBs seroconversion	* No further ongoing care for patients without cirrhosis, * Liver ultrasound once yearly for patients with cirrhosis	* Cure drug costs: depending on cost-saving or cost-effectiveness threshold *Liver ultrasound: US$125 (USA) US$19 (China) US$258

We assume during the first year (during initial treatment, pre-cure), everyone in the partial and functional cure will get monitoring twice for HBV DNA, ALT, and liver ultrasound

Table 2. Life-long per person QALYs gained and costs saved with partial and functional cure compared with current long-term antiviral therapy with ETV or TDF

	USA		**China**		**Australia**	
	No Cirrhosis	**Cirrhosis**	**No Cirrhosis**	**Cirrhosis**	**No Cirrhosis**	**Cirrhosis**
QALYs gained						
Partial cure vs. Current antiviral therapy	0.04	0.20	0.05	0.22	0.04	0.20
Functional cure vs. Current antiviral therapy	0.08	0.56	0.09	0.59	0.08	0.56
Monitoring costs saved						
Partial cure vs. Current antiviral therapy	($33)	($89)	($5)	($15)	($51)	($121)
Functional cure vs. Current antiviral therapy	$1,921	$949	$299	$149	$2,650	$918
Disease management costs saved						

Partial cure vs. Current antiviral therapy	$2,121	$5,834	$335	$771	$706	$2,231
Functional cure vs. Current antiviral therapy	$2,864	$9,061	$491	$1,383	$1,094	$3,815
Long-term antiviral Drug Treatment costs saved*						
Partial cure vs. Current antiviral therapy	$1,901	$2,013	$210	$221	$7,208	$7,630
Functional cure vs. Current antiviral therapy	$1,909	$1,934	$211	$212	$7,238	$7,329
Total savings (not including cure drug costs)						
Partial cure vs. Current antiviral therapy	$3,990	$7,759	$540	$977	$7,863	$9,739
Functional cure vs. Current antiviral therapy	$6,694	$11,944	$1,001	$1,744	$10,983	$12,063

*Assuming cure effectiveness at 30%, and the other 70% not cured continues to receive ETV or TDF at current pricing

Figure legends

Figure 1. Cost-breakdown for each scenario in patients with and without cirrhosis in USA, China and Australia

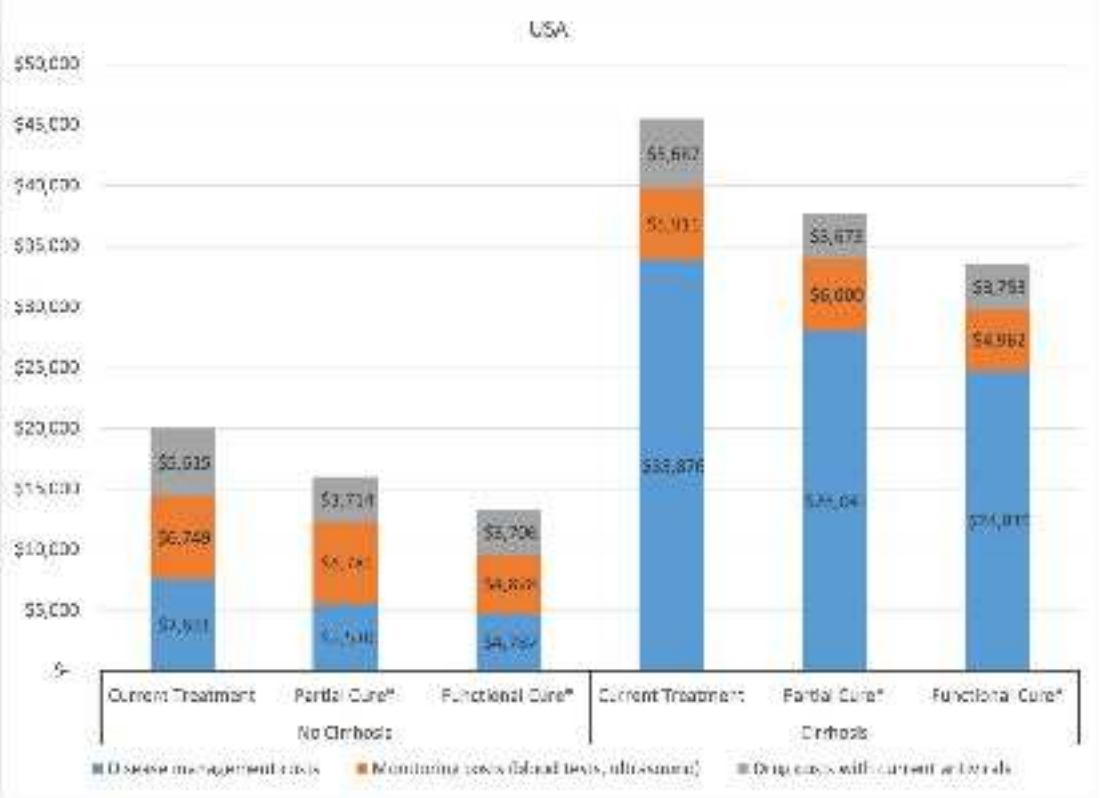
* Assuming 30% effectiveness

Figure 2. Price threshold for a partial and functional cure to be cost saving and highly cost-effective compared with current long-term antiviral therapy in patients with and without cirrhosis in the USA, China, and Australia

Figure 2A. Threshold drug cost for a cure in the USA

Figure 2B. Threshold drug cost for a cure in China

Figure 2C. Threshold drug cost for a cure in Australia



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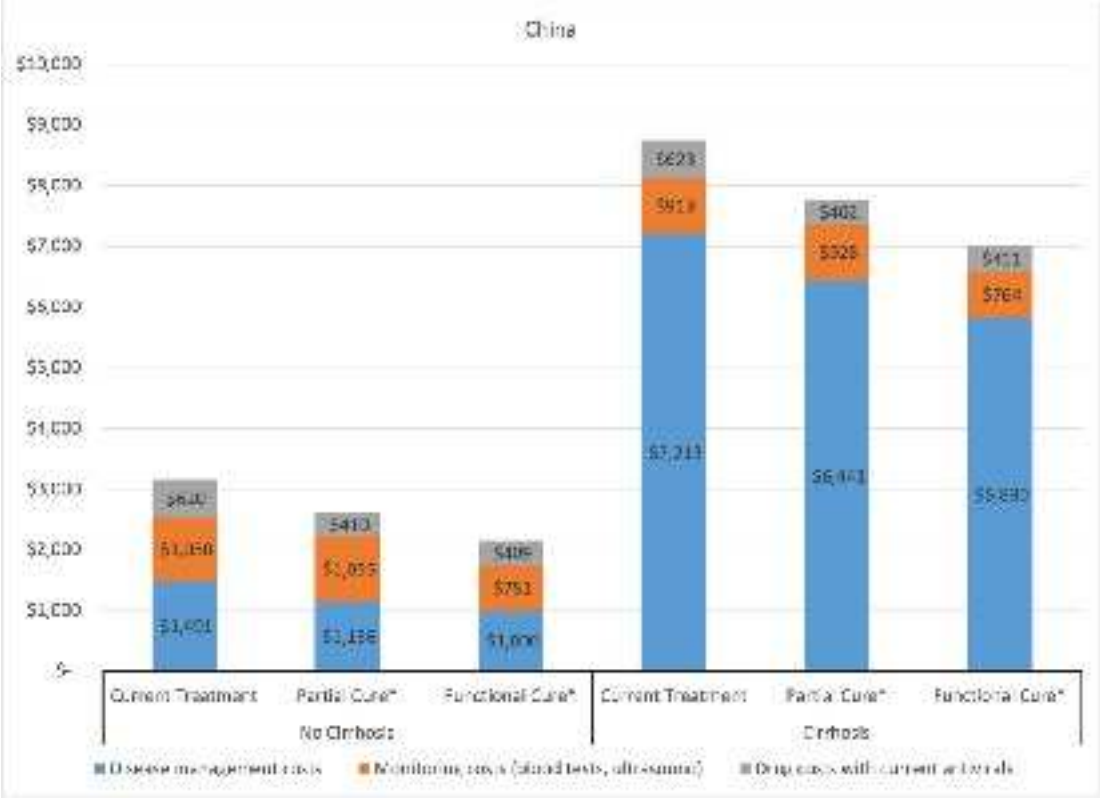

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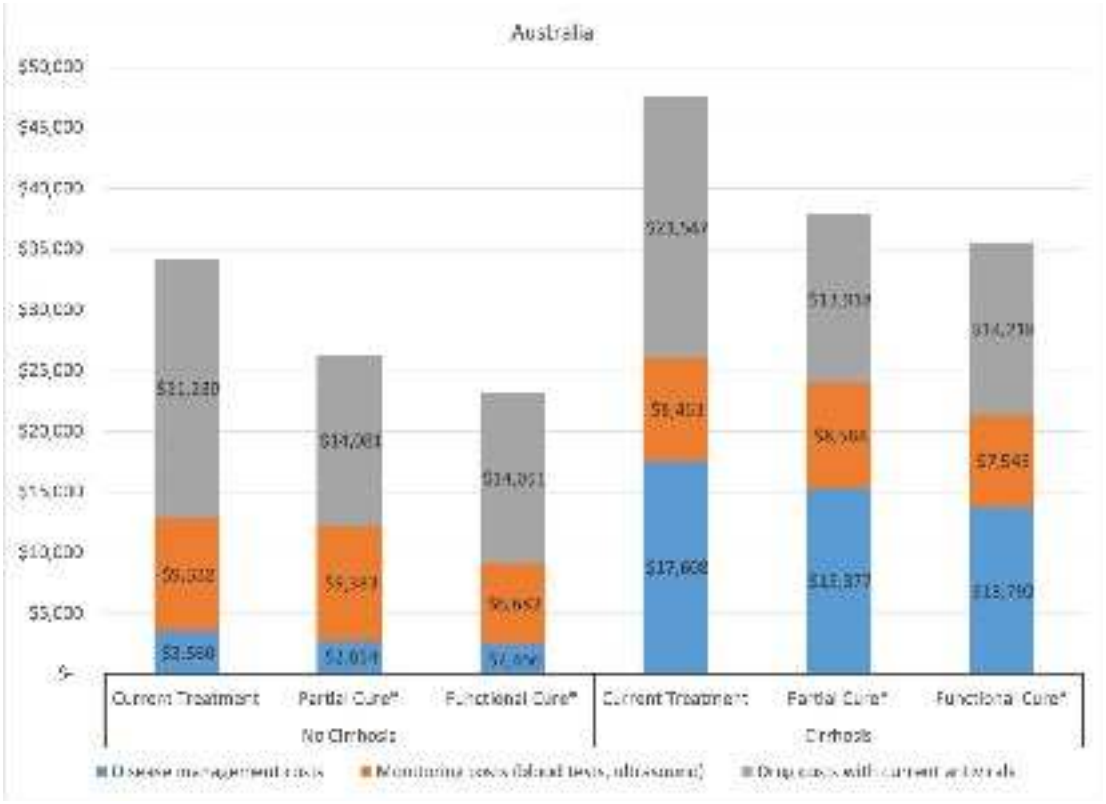

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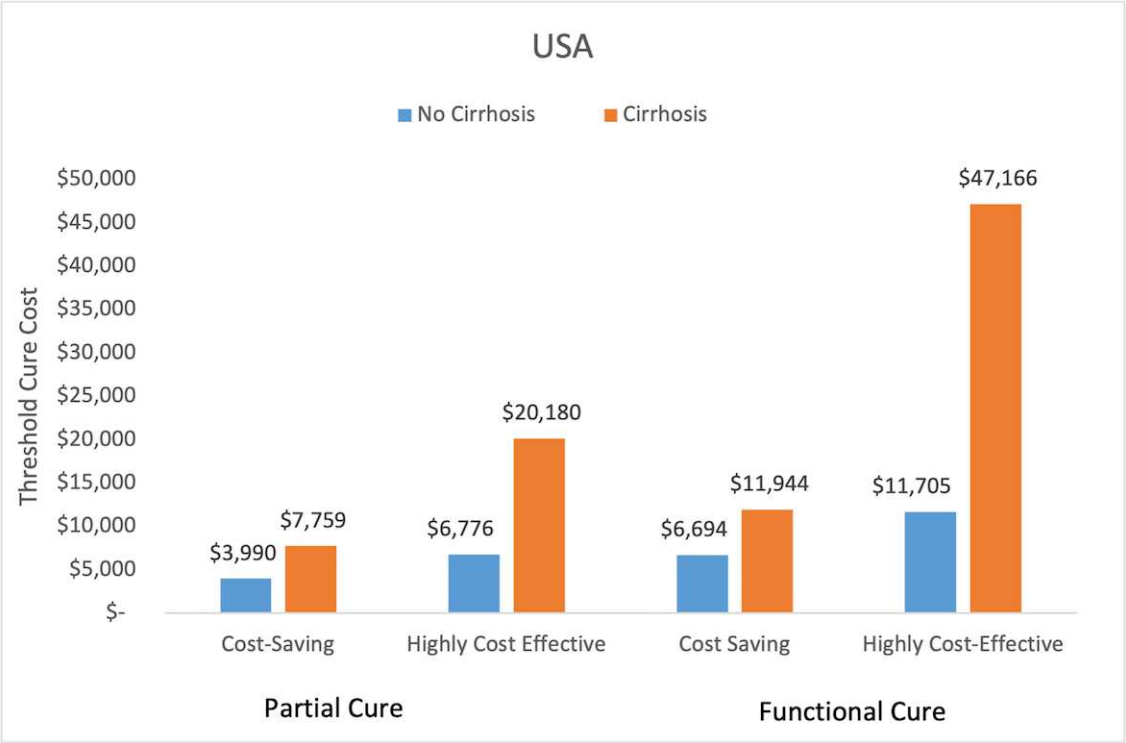

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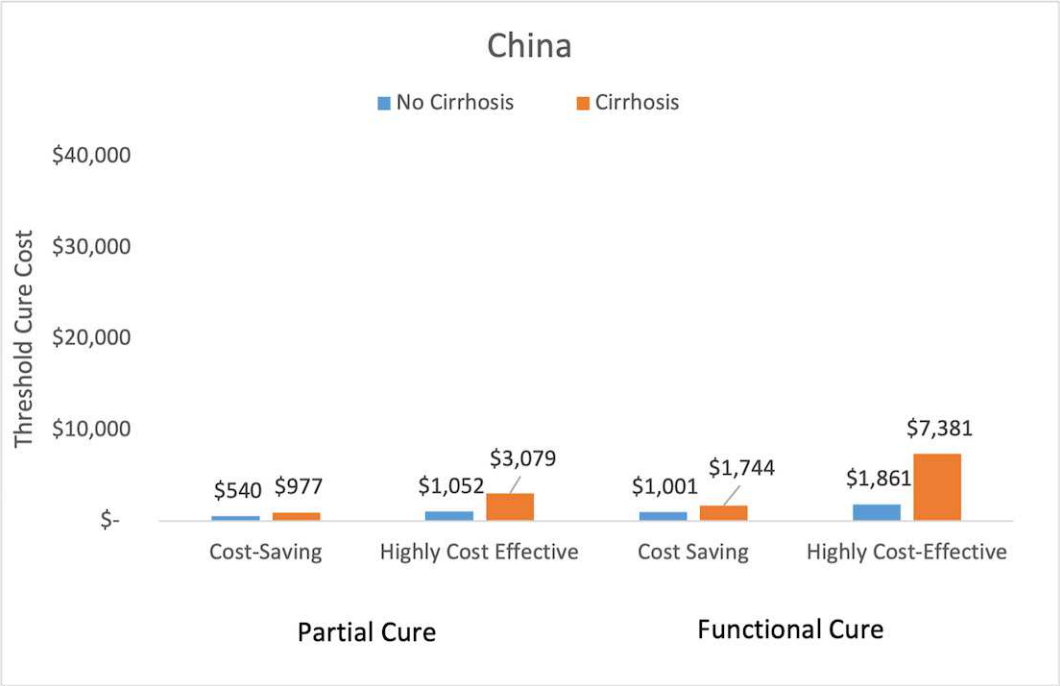

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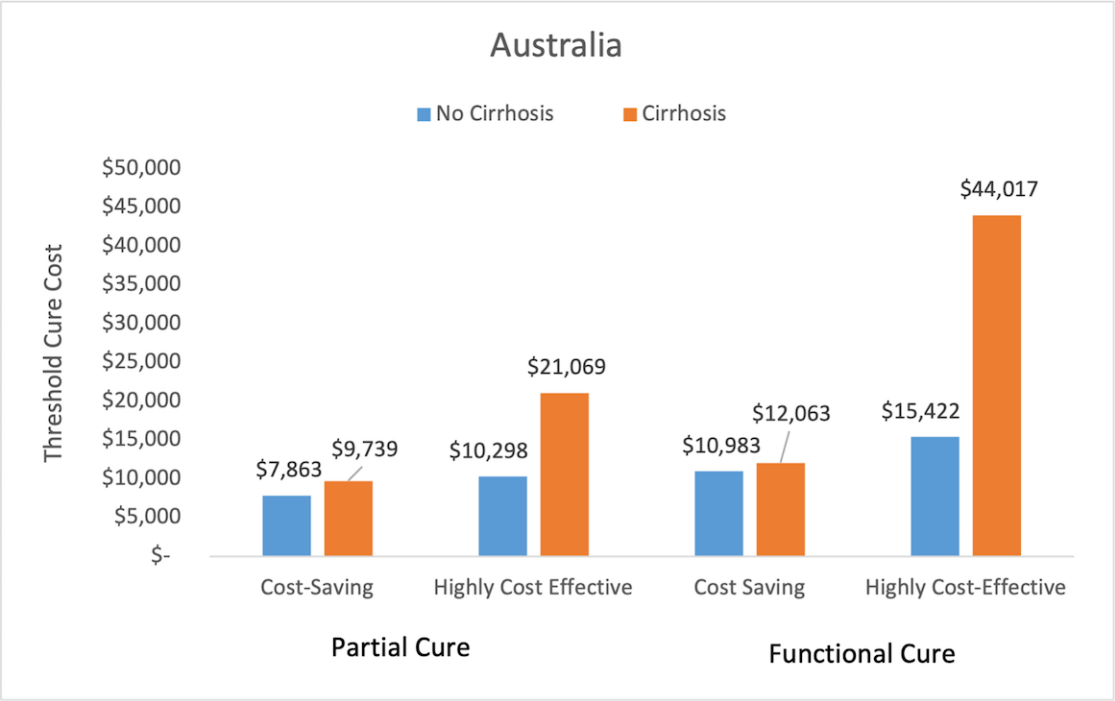

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