Cost-Effectiveness of Ravidasvir Plus Sofosbuvir Compared to the Standard of Care in Patients with Chronic Hepatitis C in the Thai Healthcare Setting

COLLEGE OF PHARMACY UNIVERSITY OF UTAH
L. S. SKAGGS PHARMACY INSTITUTE

Teerawat Nonthasawadsri[1], Tawesak Tanwandee[2], Usa Chaikledkaew[3], Daniel Malone[1]

[1]Department of Pharmacotherapy, College of Pharmacy, University of Utah, Salt Lake City, Utah, United States of America
[2]Division of Gastroenterology and Hepatology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand;
[3]Department of Pharmacy, Faculty of Pharmacy, Mahidol University, Bangkok, Thailand

BACKGROUND

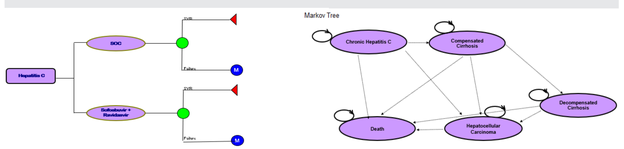
- Hepatitis C virus (HCV) is a viral infection that may lead to cirrhosis, liver failure, and liver cancer
- Chronic HCV infection is an important global health problem, with approximately 71 million people infected
- Nowadays, recommends therapy with pan-genotypic direct-acting antivirals (DAAs), combined with antiviral drugs to target stages of the hepatitis C virus reproductive cycle
- Ravidasvir is an NS5A inhibitor in clinical trials for chronic hepatitis c which the efficacy and safety in combination with the sofosbuvir showing that 97% were cured after 12 weeks of treatment
- It is worth exploring the cost-effectiveness of this medication to see if could become an alternative choice to facilitate the policy implementation for such patients that could not be able to afford the previous treatment regimens

OBJECTIVE

To estimate the cost-effectiveness of ravidasvir plus sofosbuvir versus the standard-of-care (pegylated interferon plus ribavirin) for treating chronic hepatitis C with genotypes 1 and 6 patients in Thailand

METHODS

Overview



- The cost-effective analysis was performed using a Markov model adopted from a published study
- Treatment compared between the standard-of-care treatment (pegylated interferon plus ribavirin) and the new treatment (ravidasvir plus sofosbuvir) for 24 weeks
- A lifetime horizon was utilized in this model
- All analyses were based on a societal perspective
- Base-case and sensitivity analyses were performed

METHODS

- The hypothetical cohort of hepatitis c patients aged 18-69 years and their disease progression were simulated in the Markov model
- The model simulated the progression of chronic HCV infection (CHC) to compensated cirrhosis (CC), decompensated cirrhosis (DC), hepatocellular carcinoma (HCC), and death
- Patients who did not achieve SVR transitioned into the natural history phases of HCV infection

Data sources and data analysis

- Results were presented as incremental cost-effectiveness ratios (ICERs) in 2022 US dollars (USD) per quality-adjusted life year (QALY) gained
- The willingness-to-pay (WTP) threshold is $5,000 USD/QALY (160,000 Thai Bath (THB)/QALY)
- The cycle length was one year, and a 3% discount rate was applied for estimating the future costs and benefits, as recommended in the health technology assessment guidelines of Thailand
- The data were obtained from previous literature
  - Transitional probabilities between health states
  - Efficacies of the drug combination
    - Reported as SVR rates
  - Direct medical and direct non-medical costs incurred from each treatment regimen, including the cost of antiviral agents
    - All costs were converted to 2022 values based on the time of data analysis using the Thai consumer price index and presented in US dollars (USD) (approximately THB 35 = USD 1 in 2022
  - Utility values of patients with chronic HCV infection and complications

chronic HCV to compensated cirrhosis year 1-10	0.0057	0.0057	Beta
chronic HCV to compensated cirrhosis year 11-20	0.0143	0.0141	Beta
chronic HCV to compensated cirrhosis year 21-30	0.0207	0.0203	Beta
chronic HCV to HCC year 1-10	0.0007	0.0007	Beta
chronic HCV to HCC year 11-20	0.0032	0.0032	Beta
chronic HCV to HCC year 21-30	0.0063	0.0062	Beta
chronic HCV to death	0.0070	0.0070	Beta
compensated cirrhosis to decompensated cirrhosis year1-3	0.0417	0.0400	Beta
compensated cirrhosis to decompensated cirrhosis year 4-5	0.0945	0.0855	Beta
compensated cirrhosis to decompensated cirrhosis year 6-10	0.0662	0.0618	Beta
compensated cirrhosis to HCC year 1-3	0.0135	0.0133	Beta
compensated cirrhosis to HCC year 4-5	0.0356	0.0344	Beta
compensated cirrhosis to HCC year 6-10	0.0297	0.0288	Beta
compensated cirrhosis to death year 1-3	0.0135	0.0133	Beta
compensated cirrhosis to death year 4-5	0.0461	0.0439	Beta
compensated cirrhosis to death year 6-10	0.0461	0.0439	Beta
decompensated cirrhosis to HCC	0.0681	0.0635	Beta
decompensated cirrhosis to death year 1	0.2920	0.1924	Beta
decompensated cirrhosis to death year 2	0.3900	0.2379	Beta
decompensated cirrhosis to death year 3-5	0.2394	0.1821	Beta
HCC to death year 1	0.8482	0.0011	Beta
HCC to death year 2	0.9201	0.0009	Beta

Visit	SVR	95% CI of SVR
Follow-up Wk 4	586/602 (97.3%)	95.7% to 98.5%
Follow-up Wk 12	583/602 (96.8%)	95.1% to 98.1%
Follow-up Wk 24	580/602 (96.3%)	94.5% to 97.7%

Costs	Mean (THB)[7]	Distribution[8]
Antiviral combination therapy (per course)		
PEG-RBV for 24 weeks	75,600	Gamma
PEG-RBV for 48 weeks	151,200	Gamma
SOF + PEG-RBV for 12 weeks	163,800	Gamma
SOF + DCV for 12 weeks	252,000	Gamma
SOF + LDV for 12 weeks	166,500	Gamma
Laboratory tests for investigation and monitoring (per course)		
HCV genotype testing	5,410	Gamma
PEG-RBV for 24 weeks	17,100	Gamma
PEG-RBV for 48 weeks	20,200	Gamma
SOF + PEG-RBV for 12 weeks	8,700	Gamma
SOF + DCV for 12 weeks	8,700	Gamma
SOF + LDV for 12 weeks	14,100	Gamma
Treatment costs of HCV complication (per year)		
Chronic HCV infection	72,000	Gamma
Compensated cirrhosis	80,000	Gamma
Decompensated cirrhosis	148,300	Gamma
Hepatocellular carcinoma	183,800	Gamma
Anemia	8,317	Gamma
Direct-non-medical costs		
Chronic HCV infection (per year)	4,470	Gamma
Compensated cirrhosis (per year)	6,380	Gamma
Decompensated cirrhosis (per year)	6,060	Gamma
Hepatocellular carcinoma (per year)	9,900	Gamma
Hospital visit, outpatient service (per visit)	670	Gamma

Health states	Mean	SE	Distribution[9]
Chronic HCV infection	0.73	0.0013	Beta
Compensated cirrhosis	0.70	0.0020	Beta
Decompensated cirrhosis	0.58	0.0020	Beta
Hepatocellular carcinoma	0.54	0.0023	Beta
Anemia in chronic HCV infection[5]	0.61	0.0018	Beta

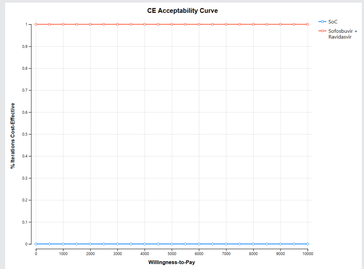
RESULTS

Base case analysis

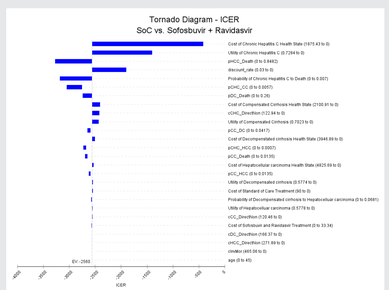
Strategy	Cost (USD)	Incremental Cost (USD)	Effect (Year)	Incremental Effect (Year)	ICER	Category
PEG+RBV	14,000		21.623			
RVD+SOF	2,053	-11,947	26.289	4.666	-2,560	Dominant

- Compared to the standard-of-care treatment, ravidasvir plus sofosbuvir treatment provided a negative ICER
- Ravidasvir plus sofosbuvir treatment was dominant, with a cost-saving of 11,947 USD

Sensitivity analysis



- The probability of being cost-effective for ravidasvir plus sofosbuvir treatment was 1 compared to 0 for the standard-of-care treatment at the willingness-to-pay threshold of 5,000 USD



- The cost of chronic hepatitis c health state was found to be the most influential variable to influence the ICER of the ravidasvir plus sofosbuvir treatment compared to the standard-of-care treatment

DISCUSSION & CONCLUSIONS

Discussion

- The findings have shown that using the newly developed treatment with ravidasvir plus sofosbuvir had lower costs and higher outcomes than the standard-of-care treatment with pegylated interferon plus ribavirin
- This study contradicts the previous studies since ravidasvir is the new medication that turns out to cost less than previous medications
- There have been some limitations;
  - The variation in the cost of medications, which might affect the result
  - The lack of some input parameters of some genotypes of the hepatitis c virus, which makes this study might not be able to assess the results of all genotypes of the virus

Conclusions

- Treating chronic hepatitis C patients with ravidasvir plus sofosbuvir is a cost-saving intervention
- This newly developed medication may potentially become a more convincing choice for the treatment of hepatitis c in the future, especially in the countries which may be having the constrain of the DAAs medication affordability

REFERENCES

1. U.S. Department of Health and Human Services. (n.d.). Hepatitis C. National Institute of Diabetes and Digestive and Kidney Diseases. Retrieved August 29, 2022, from https://www.niddk.nih.gov/health-information/liver-disease/viral-hepatitis/hepatitis-c
2. Chuaypen N, Khlaiphuengsin A, Prasoppokakorn T, et al. Prevalence and genotype distribution of hepatitis C virus within hemodialysis units in Thailand: role of HCV core antigen in the assessment of viremia. BMC Infect Dis. 2022;22(1):79. Published 2022 Jan 22. doi:10.1186/s12879-022-07074-2
3. World Health Organization. (n.d.). Hepatitis C. World Health Organization. Retrieved August 29, 2022, from https://www.who.int/news-room/fact-sheets/detail/hepatitis-c
4. Wikimedia Foundation. (2022, July 19). Direct-acting antivirals. Wikipedia. Retrieved August 29, 2022, from https://en.wikipedia.org/wiki/Direct-acting_antivirals
5. Wikimedia Foundation. (2021, August 10). Ravidasvir. Wikipedia. Retrieved August 29, 2022, from https://en.wikipedia.org/wiki/Ravidasvir
6. Andrieux-Meyer, I., et. Al. (2021). Efficacy and safety of ravidasvir plus sofosbuvir in patients with chronic hepatitis C infection without cirrhosis or with compensated cirrhosis (STORM-C-1): interim analysis of a two-stage, open-label, multicentre, single arm, phase 2/3 trial.The lancet. Gastroenterology & hepatology, 6(6), 448–458.
7. Ravidasvir + sofosbuvir: Dndi. Drugs for Neglected Diseases initiative (DNDi). (2022, August 24). Retrieved August 29, 2022, from https://dndi.org/research-development/portfolio/ravidasvir-sofosbuvir/
8. Kapol N, Lochid-Amnuay S, Tearawattananon Y. Economic evaluation of pegylated interferon plus ribavirin for treatment of chronic hepatitis C in Thailand: genotype 1 and 6. BMC Gastroenterol. 2016;16(1):91. Published 2016 Aug 5. doi:10.1186/s12876-016-0506-4
9. Rattanavipapong W, Anothaisintawee T, Teerawattananon Y. Revisiting policy on chronic HCV treatment under the Thai Universal Health Coverage: An economic evaluation and budget impact analysis. PLoS One. 2018;13(2):e0193112. Published 2018 Feb 21. doi:10.1371/journal.pone.0193112

teerawat.nonthasawadsri@utah.edu