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RESEARCH

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Prevalence-based screening by anti-HCV reflex HCV antigen test and accessible post-screening care towards elimination of hepatitis C in rural villages

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Abstract

Background One major barrier to the goals of hepatitis C virus (HCV) elimination is identification and linkage-to-care for those with HCV infection. The aim of this research was to develop a strategy to help achieve HCV elimination in remote rural villages.

Methods According to the maps of the township- and village-specific testing rates and prevalence rates of anti-HCV produced by the Public Health Bureau of Yunlin County, a high anti-HCV prevalent township Sihhu and four nearby villages were selected for an intensive screening with anti-HCV reflex HCV antigen test. A temporary outreach hepatology clinic was set in Sihhu Township Health Center to enhance accessibility for post-screening care of those positive for HCV antigen.

Results The population aged ≥ 40 years of the included villages at time of survey was 18,018 with 5,343 (29.7%, range 18.8–39.7%) having ever been previously screened, and 1,503 responded to this screening. The crude screening coverage rate increased to 38.0% (range 27.6–47.2%) after this screening campaign. The prevalence rates of anti-HCV and HCV antigen were 17.3% and 8.3% respectively, with the rate of antigenemia (HCV antigen/anti-HCV) being 48.1%. The number needed to test (NNT) to find a candidate for anti-viral treatment was 12. Patients can choose any medical institution for consultation based on their preference. The local health centers could trace the consultation status of all 125 HCV patients, with 119 of them receiving direct-acting antiviral (DAA) treatment. Out of the 125 patients with positive HCV antigen, 75 were evaluated at the outreach clinic, with 70 ultimately receiving DAA treatment at the outreach clinic and 5 receiving treatment at other hospitals. Evaluable sustained virological response rate for the 70 patients was 97%.

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Conclusion Prevalence-based screening and accessible outreach clinic can help accelerate HCV elimination in rural villages.

Keywords Hepatitis C virus, Micro-elimination, Outreach clinic, Prevalence, Screening

Introduction

Hepatitis C virus (HCV) has long been a major public health problem with 0.7%, corresponding to 56.8 million, of worldwide population living with a viremic infection as estimated in 2020 [1]. Chronic HCV infection is not only a major cause of liver cirrhosis and hepatocellular carcinoma but also increases the mortality rates of many hepatic and extrahepatic diseases [2]. With the absence of an approved HCV vaccine regimen, attaining a sustained virological response (SVR), defined as no detectable HCV RNA in serum at six months after interferon-based or at three months after direct-acting antiviral (DAA) treatments, is the only means of eliminating HCV-related complications [3].

The launch of all-oral DAA therapies with SVR rates of more than 95% in 2014 drastically improved the management of HCV [4, 5]. These highly efficacious therapies also granted the World Health Organization to set tremendous goals for the elimination of HCV as a public health threat in 2016 and subsequently released a roadmap to achieve this target by the year 2030 [6]. However, drugs alone are not enough and the target towards HCV elimination is challenging as more than half of countries were off track by at least 20 years as the reported progress between 2017 and 2019 [7]. The elimination programs were further stalled by the outbreak of COVID-19 which subsequently became a pandemic worldwide in 2020 [8]. As a result, some innovative countermeasures are emergently needed to accelerate the path towards success especially for the countries fallen behind the track.

In Taiwan, the prevalence of anti-HCV seropositivity was approximately 3.3% in general population, corresponding to an estimated 400,000 out of a population of 23 million with a viremic infection as HCV RNA seropositivity accounted for about 65% of the reactive anti-HCV population [9, 10]. Taiwan has committed to eliminating hepatitis C by 2025 and the Taiwan Hepatitis C Policy Guideline 2018–2025 has highlighted three core strategies including precision public health, continuum of care and localized care delivery [10]. Since the cost of DAA therapy was reimbursed by the National Health Insurance in Taiwan, one key component to achieve HCV elimination is defining and prioritizing intervention for highly prevalent populations and hyperendemic areas [11].

Yunlin County, located in midwestern Taiwan, is hyperendemic for HCV with an anti-HCV prevalence rate of 15.4% for persons 40 years or older [12]. The village-specific anti-HCV prevalence rates ranging from 3.8 to 85.8% indicate obvious geographic disparities in Yunlin County [12]. Yunlin is an agricultural and fishery county with very limited accessible medical resources in its many remote townships and villages [12, 13]. To achieve high efficacy and cost-effectiveness, a tailored strategy should be employed for micro-elimination of HCV to meet the needs of local administrative districts with different prevalence and resources [14]. Here, we demonstrated a concerted effort conducted by county governance and healthcare providers to accelerate micro-elimination for rural townships by a prevalence-based precision screening using anti-HCV reflex HCV antigen test and accessible post-screening care.

Methods

Study population

Yunlin County had a total population of 679,468 as of May 2020 according to its Household Registration information. To efficiently estimate the prevalence of HCV, Yunlin County Public Health Bureau integrated readily available anti-HCV test results within the county's jurisdiction from hospital-based screening in eight major hospitals and community-based screenings conducted by local Health Centers and nongovernment organizations to develop maps to estimate the township- and village-specific testing rates and prevalence rates of anti-HCV [12]. The village-specific anti-HCV prevalence rates were validated by executing an intensive screening in Kouhu Township, a township with a wide range of village-specific prevalence rates, though the hospital-based data tended to slightly overestimate the community screening results [12]. Sihhu Township, a township of 21 villages with a total population of 22,622 as of May 2020 located on the southwestern coast of Yunlin County, was prioritized for a micro-elimination program for the high anti-HCV prevalence rates of >20% in 15 of its 21 villages. Four nearby villages in Beigang Township with anti-HCV prevalence rates of >30% were also included.

Survey

For disease control and prevention, the above-mentioned anti-HCV dataset was linked to the database of the Household Registration Service of Yunlin County to locate the resident township and village of all individuals with available anti-HCV data. The intensity of screening was then determined based on the anti-HCV prevalence rates. For areas with high anti-HCV prevalence, accessible screening was carried out for the entire township or selected villages using an anti-HCV reflex

HCV antigen test. The local Health Centers of Sihhu and Beigang Townships conducted village-to-village screening during May 2020 to July 2020 for residents with official household registration and were 40 years or older. To achieve precision screening, only individuals without available anti-HCV data in the dataset, namely screening-naïve residents, were invited by mail and/or phone call. Staff members of the Health Centers visited every village for at least three times to obtain blood samples. Written informed consent was obtained from all participants. All HCV antigen-reactive patients were referred for DAA treatment. As there was no any gastroenterologist in Sihhu Township at the time of survey, a temporary biweekly outreach hepatology clinic supported by Yunlin Chang Gung Memorial Hospital was set in Sihhu Health Center to enhance accessibility for post-screening care. The outreach hepatology clinic proactively notified eligible patients for laboratory tests including hemogram, biochemistry, HCV RNA level, HCV genotype, ultrasonography examination and provided DAA treatment for eligible patients. Those with a reactive anti-HCV test in the dataset were notified by the hospitals or the Health Centers where they have received anti-HCV test to return for a confirmatory HCV RNA test. Figure 1 shows Sihhu Township close to the west of Beigang Township which has two hospitals and two hepatology clinics. Patients could choose the most accessible one for HCV treatment according to their preference.

Laboratory tests

The anti-HCV level was determined by using the Abbot Architect i2000 SR device (Abbot Diagnostics, Chicago, IL, USA). The HCV antigen assay was performed by a two-step chemiluminescent microparticle immunoassay using ARCHITECT HCV core antigen detection assay (Abbot Diagnostics, Chicago, IL, USA), with samples being divided into a liquid phase with acridinium-labelled murine anti-HCV antibodies and a solid phase with paramagnetic microparticles for quantitative measurement of the HCV antigen. Specimens with levels of ≥ 3 fmol/L were considered to be reactive for HCV antigen, whereas those with levels of < 3 fmol/L were considered to be non-reactive. HCV RNA levels were determined by Cobas AmpliPrep/Cobas TaqMan HCV quantitative test v2.0 (Roche Molecular Systems, South Branchburg, USA, lower limit of detection [LLOD]: 15 IU/mL across all HCV genotypes). HCV genotype was determined by Cobas HCV GT kit based on the Cobas 4800 system from Roche Diagnostics (Roche Molecular Systems, Pleasanton, CA, USA). All blood tests were done in a central laboratory.

Statistical analysis

SAS version 9.4 (SAS Institute, Cary, NC, USA) was used to calculate the screening and prevalence rates, number needed to test (NNT) to find a candidate for antiviral

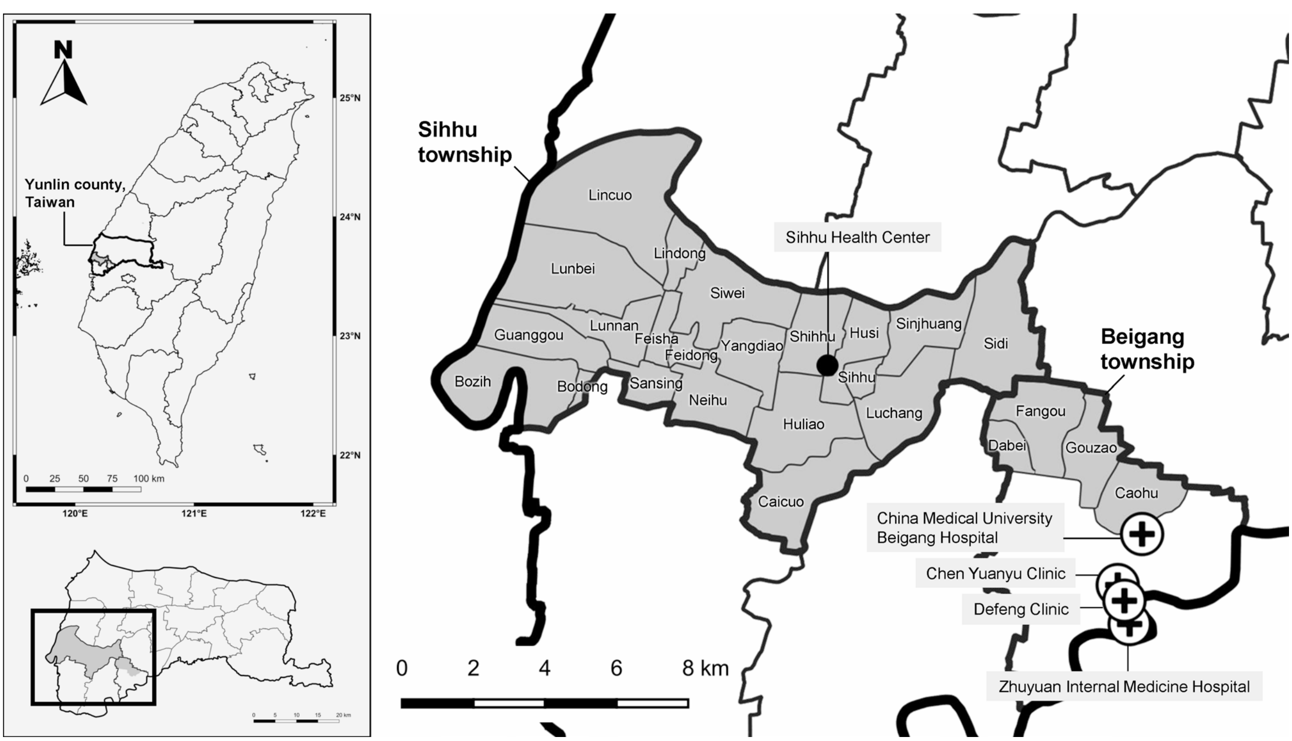


Fig. 1 The location of Sihhu Township and the four nearby villages in Beigang Township, Yunlin County, along with the distribution of medical resources in these two townships

treatment and the demographic data of the treated patients.

Results

Screening coverage and prevalence rates of anti-HCV and HCV antigen

As shown in Table 1, the registration population of those aged 40 years or older was 18,018 for the 25 villages included in this survey. Of them, 5,343 (29.7%, range 18.8-39.7% by villages) had ever been screened before, and 1,503 responded to this screening. The crude screening coverage rate increased to 38.0% (range 27.6–47.2% by villages) after this screening campaign. The village-specific screening coverage rate changes before and after the screening campaign was demonstrated in Fig. 2A and B.

Table 2 showed the prevalence rates of anti-HCV, HCV antigen and NNT of individual village according to this screening. For the 1,503 participants (range 29–132 by villages), 260 (17.3%, range 2.3-55.8% by villages) were anti-HCV-positive and 125 (8.3%, range 0-40.4% by villages) were HCV antigen-positive. The rate of antigenemia (HCV antigen/anti-HCV) was 48.1% (range 0-76.5% by villages). The overall NNT for a treatment candidate was 12. The village-specific anti-HCV prevalence rate changes before and after the screening campaign was demonstrated in Fig. 2C and D.

Demographic characteristics of the 70 patients receiving DAA treatment at the outreach clinic

As there was no any gastroenterologist in Sihhu Township at the time of survey, a temporary biweekly outreach hepatology clinic was set in Sihhu Health Center to enhance accessibility for post-screening care (Fig. 1). From May 2020 to April 2021, a total of 70 HCV antigen-positive patients completed evaluation and DAA treatment at the outreach clinic. All of them were viremic. As shown in Table 3, the median HCV RNA level was 2,620,648 (range 560 – 21,707,877) IU/mL with 49 (70%) had an HCV RNA level of ≥ 800,000 IU/mL. The most common genotype was 1b (34 or 48%) followed by 2 (31 or 44.3%), 1a (2 or 2.9%), 6 (2 or 2.9%) and 1a + 1b (1 or 1.4%). The median age was 67 (range 39–83) years and the male-to-female ratio was 34:36. All 70 patients were treatment-naïve and had no previous hepatocellular carcinoma. Three (4.3%) of them had HBV coinfection, 11

Table 1 The screening coverage rate changes of individual village

Village	Population aged 40 years or older (A)	Ever been screened, *n* (%) (B)	Screening-naïve (C = A-B)	Participants of this screening (D)	Crude screening coverage rate (E=(B + D)/A)
Bozih	703	169 (24.0%)	534	43	30.2%
Bodong	788	196 (24.9%)	592	40	29.9%
Sansing	269	65 (24.2%)	204	29	34.9%
Neihu	562	120 (21.4%)	442	53	30.8%
Sihhu	1219	464 (38.1%)	755	111	47.2%
Yangdiao	719	196 (27.3%)	523	51	34.4%
Lindong	733	241 (32.9%)	492	38	38.1%
Lincuo	804	242 (30.1%)	562	53	36.7%
Shihhu	891	300 (33.7%)	591	64	40.9%
Feisha	644	199 (30.9%)	445	59	40.1%
Feidong	396	115 (29.0%)	281	43	39.9%
Lunbei	1290	325 (25.2%)	965	83	31.6%
Lunnan	601	155 (25.8%)	446	38	32.1%
Luchang	693	186 (26.8%)	507	73	37.4%
Husi	1518	603 (39.7%)	915	89	45.6%
Huliao	542	178 (32.8%)	364	43	40.8%
Sinjhuang	474	133 (28.1%)	341	34	35.2%
Siwei	521	98 (18.8%)	423	46	27.6%
Sidi	695	221 (31.8%)	474	65	41.2%
Guanggou	518	128 (24.7%)	390	48	34.0%
Caicuo	659	210 (31.9%)	449	42	38.2%
Dabei	425	147 (34.6%)	278	51	46.6%
Caohu	936	244 (26.1%)	692	132	40.2%
Fangou	604	204 (33.8%)	400	52	42.4%
Gouzao	814	204 (25.1%)	610	123	40.2%
Total	18,018	5343 (29.7%)	12,675	1503	38.0%

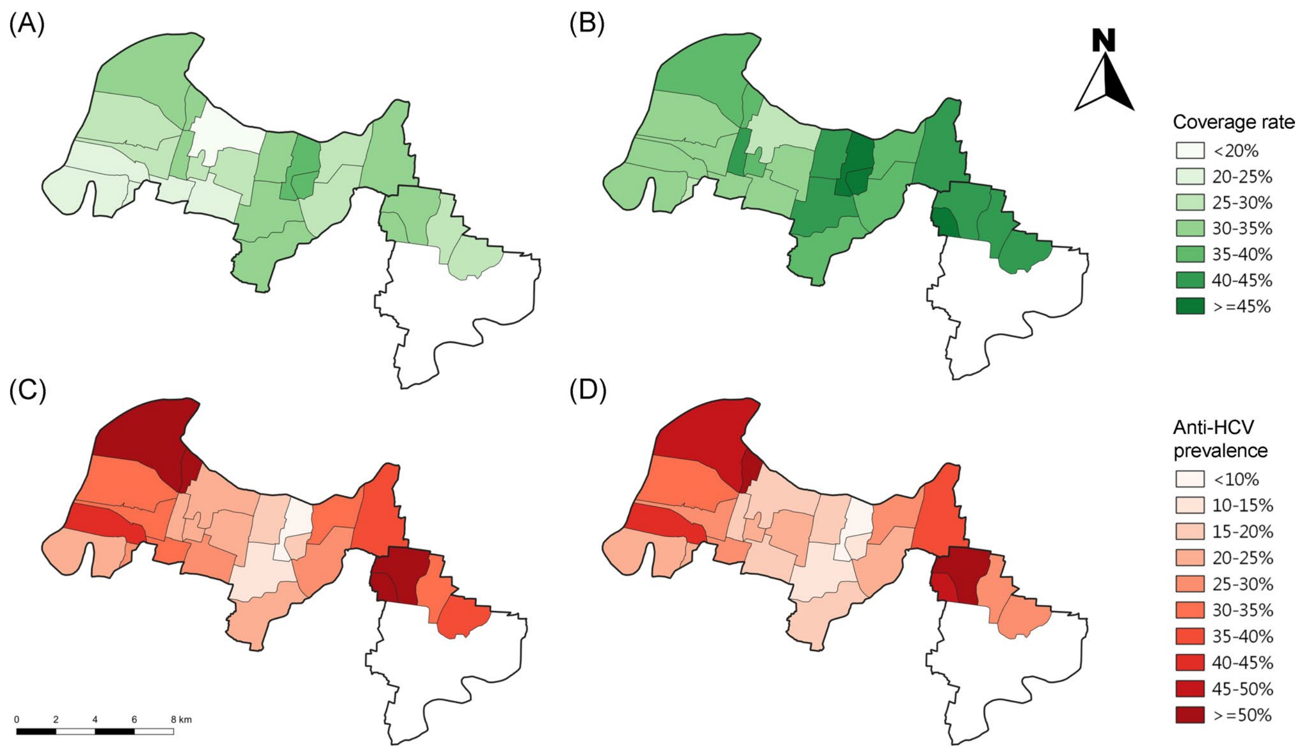


Fig. 2 **A** and **B** illustrate the changes in the village-specific anti-HCV testing coverage rates before and after the screening campaign. **C** and **D** show the changes in the village-specific anti-HCV prevalence rates before and after the screening campaign

(15.7%) had diabetes mellitus and 64 (91.4%) had a FIB-4 score of ≤ 3.25. The median aspartate aminotransferase was 29 (range 17–98) U/L, alanine aminotransferase 32.5 (17–261) U/L, albumin 4.25 (3.5–4.8), total bilirubin 0.4 (0.2–1.7) mg/dL, creatinine 0.83 (0.56–3.34) mg/dL, estimated glomerular filtration rate 82.3 (14.2-149.3) mL/min/1.73m^2, alpha-fetoprotein 2.75 (1.1–9.9) ng/mL, hemoglobin 13.7 (7.2–17) g/dL, white cell count 6.1 (3.2–21.1) 10^{3}cells/L, and platelet count 208 (112–331) 10^{9}cells/L. The overall SVR rate was 90% (63/70) and the evaluable SVR rate was 97% (63/65). Both the two patients who did not attained SVR were due to poor drug compliance. The remanding 5 patients declined to be back for SVR evaluation.

Patient care cascade: from screening to SVR

The local health centers traced the consultation status of all 125 hepatitis C patients, with 119 of them receiving DAA treatment. Figure 3 showed the patient care cascade from screening to SVR of this study.

Discussion

Micro-elimination, which breaks down national elimination targets into goals for smaller and more manageable subpopulations, is a more effective and practical manner for elimination of HCV [14]. The key step of this approach is identifying the subpopulations who share the characteristics of being highly prevalent for or vulnerable to HCV infection. Certain subpopulations, including uremic patients undergoing hemodialysis, incarcerated people, people who inject drugs, sex workers, transgender and gender-diverse populations, and men who have sex with men with or without human immunodeficiency virus infection are universally-established high risk groups that should be prioritized for intervention [11, 14]. For the general population, extremely labor- and financial-intensive epidemiological surveys are usually necessary to identify areas where HCV are particularly prevalent. Understanding the burden of viral hepatitis is also essential for stakeholders embarking on hepatitis care programs. In this study, we demonstrated that active government involvement effectively reduced the tremendous resources required for universal community screening. Yunlin County Public Health Bureau integrated readily available anti-HCV test results within the county's jurisdiction to develop the township- and village-specific testing rates and prevalence rates of anti-HCV. Furthermore, linkage of the anti-HCV dataset to the Household Registration information of Yunlin County helped locate the resident township and village of all individuals and facilitated precision screenings [12].

The intensity of screening efforts should be determined based on the prevalence rates with priority and more intensive screening given to higher prevalent areas since the higher the prevalence rate of anti-HCV, the lower the NNT to find a candidate for anti-viral treatment, and the

Table 2 The prevalence rates of anti-HCV, HCV antigen and number needed to test (NNT) of individual village

Village	Participants (*N*)	Prevalence of anti-HCV (n1, (%))	Prevalence of HCV Ag (n2, (%))	Rate of antigenemia (=n2/n1) (%)	Number needed to test (NNT) (*N*/n2)
Bozih	43	4 (9.3%)	2 (4.7%)	50.0%	21.5
Bodong	40	6 (15.0%)	2 (5.0%)	33.3%	20
Sansing	29	3 (10.3%)	0 (0.0%)	0.0%	—
Neihu	53	3 (5.7%)	0 (0.0%)	0.0%	—
Sihhu	111	7 (6.3%)	4 (3.6%)	57.1%	27.8
Yangdiao	51	9 (17.6%)	4 (7.8%)	44.4%	12.8
Lindong	38	11 (28.9%)	3 (7.9%)	27.3%	12.7
Lincuo	53	21 (39.6%)	7 (13.2%)	33.3%	7.6
Shihhu	64	3 (4.7%)	0 (0.0%)	0.0%	—
Feisha	59	5 (8.5%)	2 (3.4%)	40.0%	29.5
Feidong	43	7 (16.3%)	3 (7.0%)	42.9%	14.3
Lunbei	83	14 (16.9%)	6 (7.2%)	42.9%	13.8
Lunnan	38	9 (23.7%)	5 (13.2%)	55.6%	7.6
Luchang	73	11 (15.1%)	4 (5.5%)	36.4%	18.3
Husi	89	5 (5.6%)	2 (2.2%)	40.0%	44.5
Huliao	43	1 (2.3%)	0 (0.0%)	0.0%	—
Sinjhuang	34	4 (11.8%)	2 (5.9%)	50.0%	17
Siwei	46	6 (13.0%)	2 (4.3%)	33.3%	23
Sidi	65	17 (26.2%)	13 (20.0%)	76.5%	5
Guanggou	48	16 (33.3%)	6 (12.5%)	37.5%	8
Caicuo	42	4 (9.5%)	2 (4.8%)	50.0%	21
Dabei	51	18 (35.3%)	13 (25.5%)	72.2%	3.9
Caohu	132	22 (16.7%)	10 (7.6%)	45.5%	13.2
Fangou	52	29 (55.8%)	21 (40.4%)	72.4%	2.5
Gouzao	123	25 (20.3%)	12 (9.8%)	48.0%	10.3
Total	1503	260 (17.3%)	125 (8.3%)	48.1%	12.0

higher the cost-effectiveness [15]. The major transmission route of HCV infection in Taiwan was iatrogenic transmission before the 1980s via unsterilized instruments with characteristics of geographic variations localized at village level [16]. In this study, estimating the prevalence rates down to the administrative district of village level not only accurately grasped the prevalence information, but also facilitated the implementation of precise HCV screening and post-screening care. Our previous study also revealed that the village-to-village outreach screening can help increase the accessibility of residents and uncover HCV-endemic regions in remote communities [13]. To further lowering the NNT, only persons 40 years or older were invited as the prevalence rate of HCV for those younger than 40 years was relatively low in Taiwan [16, 17].

This study showed that after this screening campaign, the screening coverage rate increased from 28.7 to 38%. However, in rural areas of Taiwan, the number of registered residents who actually live in other regions can be as high as 30–40%. Currently, hepatitis screening in Taiwan is ongoing and multifaceted, with all medical institutions nationwide actively providing free hepatitis B and C screenings. The government also offers incentives for participation. Therefore, individuals who are registered but do not actually reside in the study's rural township may still undergo screening through other channels. After September 2020, Taiwan began promoting nationwide screening with anti-HCV reflex HCV RNA tests for individuals aged 45–79, breaking down barriers between towns and townships. With the government's efforts, the HCV screening rate has reached 70% in Taiwan. Actually, the work presented in this paper served as the pilot study for the ensuing nationwide screening in Taiwan.

After HCV screening, linkage to care of the candidates for DAA treatment is another important issue to achieve the goal of HCV elimination. As there was no any hepatology clinic in Sihhu Township at the time of this survey, we set up a temporary outreach clinic in Sihhu Health Center to enhance accessibility for post-screening care. In addition to providing DAA treatment, the outreach clinic also did laboratory tests and ultrasonography to evaluate the disease status. The characteristics of the 70 viremic patients who received evaluation at the outreach clinic included high percentage of patients who were treatment-naïve (100%), had a low FIB4 score of ≤ 3.25 (91.4%) and a high platelet count as shown in Table 3. Notably, more than half these viremic patients from

Table 3 Demographic characteristics of the 70 patients receiving DAA treatment at the outreach clinic

Characteristics	Median (Range), N = 70
Age, year	67 (39–83)
Male, n (%)	34 (48.6)
Treatment naïve, n (%)	70 (100)
HBV coinfection, n (%)	3 (4.3)
Prior HCC history, n (%)	0 (0)
Diabetes mellitus, n (%)	11 (15.7)
HCV RNA ≥ 800,000 IU/mL, n (%)	49 (70)
FIB-4 ≤ 3.25, n (%)	64 (91.4)
SVR12, n (%)	
No	2 (2.9)
Yes	63 (90)
Lost to follow-up	5 (7.1)
HCV Genotype, n (%)	
1a	2 (2.9)
1b	34 (48.6)
2	31 (44.3)
6	2 (2.9)
1a + 1b	1 (1.4)
HCV RNA, IU/mL	2,620,648 (560 – 21,707,877)
Hemoglobin, g/dL	13.7 (7.2–17)
White cell count, 10^3cells/L	6.1 (3.2–21.1)
Platelet count, 10^9cells/L	208 (112–331)
Albumin, g/dL	4.25 (3.5–4.8)
Total bilirubin, mg/dL	0.4 (0.2–1.7)
AST, U/L	29 (17–98)
ALT, U/L	32.5 (17–261)
Creatinine, mg/dL	0.83 (0.56–3.34)
eGFR, mL/min/1.73m^2	82.3 (14.2-149.3)
Alpha-fetoprotein, ng/mL	2.75 (1.1–9.9)

ALT: alanine aminotransferase; AST: aspartate aminotransferase; eGFR: estimated glomerular filtration rate; FIB-4: fibrosis index based on four factors; HCC: hepatocellular carcinoma; SVR: sustained virological response

communities had normal AST and ALT levels (data not shown). The relatively mild disease severity and normal blood tests may contribute to the unawareness of HCV infection in the general population. As a result, we recommend universal comprehensive HCV screenings without restriction for the high prevalent populations in communities.

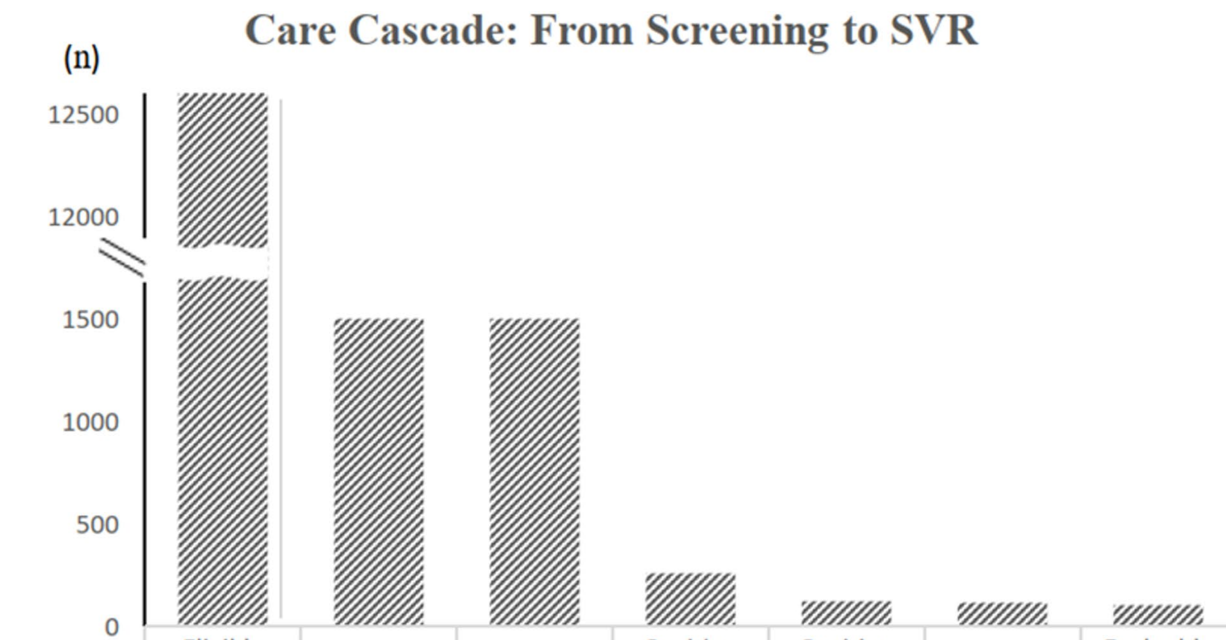
Even though an outreach hepatology clinic model can increase accessibility for HCV care in remote areas with scarce medical resources, referral of all anti-HCV-reactive subjects may still result in futile and tiring journeys as only around half of anti-HCV-reactive individuals were actually viremic according to previous studies in Taiwan [9, 13]. Although anti-HCV has been the standard tool for screening HCV and was adapted and endorsed in recent WHO guidelines [18], this traditional anti-HCV testing strategy involves a relatively expensive and complicated two-step diagnostic approach with a subsequent confirmatory nucleic acid testing in a central laboratory mandatory. The simplified single-step HCV testing strategy was revealed to be more effective and cost-effective than the traditional two-step testing approach [19]. Technically, the feasibility and cost-effectiveness of this single-step strategy would be increased if HCV RNA testing is replaced by the cheaper and easier HCV antigen testing in the outreach screening setting [20]. The latest guideline of the European Association for the Study of the Liver also recommended reflex testing for either HCVRNA or HCV antigen in patients found to be anti-HCV antibody-positives to shorten pathways to care [21]. Our previous study has demonstrated the feasibility of anti-HCV reflex HCV antigen screening in identifying viremic infection in community screenings [22] which was further validated in this study.

Limitations

First, as a local screening, this study depicted only crude screening coverage rates without adjustment, rendering estimation of HCV elimination goal achievements not feasible as the percentage of frequent residents, defined as living in the townships during the recent 6 months, was not available. Nevertheless, this study still demonstrated substantial improvement in HCV screening coverage rates after intervention. Further, those non-frequent residents would have been covered by the national level screening program implemented in September 2020. Second, the screening strategy still involved a central laboratory which may be difficult to implement in countries with large territories or limited resources. The evolving scale-up of decentralized point-of-care testing and treatment strategies may help mend this gap [23]. Third, currently, only the Abbott testing platform offers both anti-HCV and HCV antigen testing within the same platform, as no other major laboratory provider provides this combination. After this pilot study, the government promoted nationwide screening using the anti-HCV reflex HCV RNA test, which is no longer limited by the brand of the test. Lastly, since the viremic patients received evaluation and treatment in different clinics as their preference, the detailed demographic data was available only for the 70 patients treated in the outreach clinic. Nevertheless, only six of the 125 HCV antigen-reactive patients did not receive DAA treatment, one lost to follow-up, two unwilling and three with old age, making a treatment rate of 95.2% (119/125) that met the required treatment rate of 90% set by the World Health Organization [6].

Conclusion

In this study, we demonstrated a mode of precise community-based screening for screening-naïve residents using anti-HCV reflex HCV antigen test in high prevalence remote villages with a supplementary outreach



	Eligible population	Screening	Testing	Positive anti-HCV	Positive HCV Ag	Treatment	Evaluable SVR12
Number	12675	1503	1503	260	125	119	107
Proportion		100%	100%	17.3%	8.3%	7.9%	7.1%

Fig. 3 Patient care cascade: from screening to SVR

hepatology clinic for facilitating accessible post-screening care. Since all HCV antigen-positive patients evaluated in the outreach clinic tested positive for HCV RNA, we also verified that HCV antigen assay is a reliable tool in identifying viremic patients, is efficient and useful for HCV screening in the community. The localized care delivery model by setting an outreach hepatology clinic is practical to enhance accessibility for HCV care in rural areas. Finally, government involvement profoundly facilitated the effectiveness of HCV elimination programs.

Abbreviations

DAA Direct-acting antiviral
HCV Hepatitis C virus
NNT Number needed to test
SVR Sustained virological response

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Author contributions

SNL designed the study; KCP and TSC drafted the manuscript; NTH carried out the analysis and interpreted the results; YMT, YCL, HLK executed the project and collected the data; TJH and CMT supervised the project; SNL and TSC reviewed the paper for intellectual content. All authors reviewed and approved the manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Written informed consent was obtained from all participants. This study was approved by the Institutional Review Board of the Chang Gung Medical Foundation (IRB No. 201702196B0 and 202100808B0) and was conducted in accordance with the principles of the Declaration of Helsinki and the International Conference on Harmonization for Good Clinical Practice.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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