

Article

# Feasibility, Uptake, and Results of COVID-19 Antigen Rapid Diagnostic Tests Among Refugees and Migrants in a Pilot Project in Northwest Syria

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**Abstract: 1) Background:** Northwest Syria (NWS), is a conflict-affected and unstable area. Due to its limited health infrastructure, accessing advanced COVID-19 testing services is challenging. COVID-19 antigen rapid diagnostic tests (Ag-RDTs) have the potential to overcome this barrier. Therefore, a pilot project was implemented to introduce Ag-RDTs in this setting aiming to a) describe the feasibility, uptake, and results of Ag-RDTs; and b) identify facilitators and barriers to Ag-RDTs testing. **2) Methods:** A cross-sectional study design involving secondary analysis of data collected during the project's monitoring was developed. A local NGO implemented 25,000 Ag-RDTs cross boarder through trained community health workers. **3) Results:** A total of 27,888 persons were found eligible and enrolled, of which 24,956 (89.5%) consented to test and 121 (0.5%) were found positive. Highest positivity was observed among those with severe COVID-19 symptoms (12.7%), those with respiratory illnesses (2.5%), persons enrolled at Afrin Hospitals (2.5%), and healthcare workers (1.9%). A non-random sample of 236 people underwent confirmatory rt-PCR test. Accordingly, observed sensitivity, specificity, positive and negative predictive values, were 80.0%, 96.1%, 91.4% and 90.3%, respectively. Key encountered challenges included obtaining informed consent and conducting confirmatory rt-PCR testing. **4) Conclusion:** This project demonstrated great feasibility utilizing Ag-RDTs as a screening/diagnostic tool for COVID-19 infections with nearly 90% uptake. Considering the high specificity and negative predictive values and the higher positivity rates among severe COVID-19 symptomatic, embedding Ag-RDTs into COVID-19 testing strategies for ruling out and in COVID-19 infections would hold a great advantage.

**Keywords:** COVID-19; rapid diagnostic tests; refugees; prevention; Ag-RDTs; PCR

## 1. Introduction

The Middle East North Africa (MENA) countries experienced high morbidity and mortality during the COVID-19 pandemic, with over 18 million infected and over 750,000 deaths[1]. The COVID-19 pandemic has caused a significant burden on the health systems of MENA countries that cater to refugees and migrants, leading to inadequate diagnostic testing. This has resulted in refugees and migrants experiencing disproportionate access to COVID-19 testing[2,3]. Therefore, it is likely that the number of people infected and deaths due to COVID-19 were higher than reported[4].

North-West Syria (NWS), with a population of 4.6 million, is one of the world's most politically unstable geographical areas. Nearly 2.9 million people in this area are internally displaced

populations (IDPs) due to war. The population faced several challenges in accessing COVID-19 testing services due to deficiencies in the health infrastructure[5,6]. There is minimal scientific evidence about the barriers to COVID-19 testing in this setting[5]. Studies from neighbouring countries have highlighted that displaced populations face financial burdens and fear of stigma, discrimination and isolation while undergoing the COVID-19 tests[6]. In addition, the studies indicate that the pandemic was viewed mainly by refugees as “overestimated”, and many have conspiracy beliefs that have affected COVID-19 testing in these populations[6,7].

Ag-RDTs are an easier and much cheaper option than molecular reverse transcriptase polymerase chain reaction (rt-PCR) based tests[8]. Despite being more accurate, rt-PCR tests require more resources and infrastructure [9]. Nevertheless, Ag-RDTs can have high diagnostic utility in tackling the spread of COVID-19, especially in the first seven days of symptom onset[10]. Thus, they can be instrumental in settings with limited access to rt-PCR testing.

In this context, the International Organization for Migration (IOM), in collaboration with Foundation for Innovative New Diagnostics (FIND)[11] implemented a pilot project for assessing the feasibility of using COVID-19 Antigen Rapid Diagnostic Tests (Ag-RDTs) in NWS. This pilot project aimed to facilitate easy access to COVID-19 testing and to understand the barriers and best practices for diagnostic testing in this displaced population setting. In NWS, the pilot project was implemented in partnership with a local non-governmental organization—Hand in Hand for Aid and Development (HiHFAD)—and involved using 25,000 Ag-RDTs at health facilities, refugee camps, informal tented settlements (ITS) and in outreach settings.

As part of this pilot project, operational research was undertaken to document the experience of implementing Ag-RDTs in NWS. The main objectives were to: a) describe the feasibility of conducting the Ag-RDTs within camps and health facilities; b) describe the uptake of Ag-RDTs from eligible persons; c) describe the yielded results of the Ag-RDTs; and d) identify the enablers and barriers for the use of the Ag RDT tests in these settings from the perspective of the health care workers who were involved in conducting these tests within NWS.

## 2. Materials and Methods

### *Study design*

The study design was cross-sectional and involved secondary data analysis collected as part of the pilot project's recording, reporting, and monitoring processes.

### *Study population settings*

As of 2023, the population of NWS is estimated to be around 4.6 million people.[12]. The number of people needing humanitarian assistance in NWS has increased from 3.4 to 4.1 million between 2021 and 2022. Women and children make up 80% of NWS's population.[13]. About 2.9 million people in NWS are internally displaced persons (IDPs), and the majority are food insecure, with over 3 million unable to meet basic needs[12,13]. In addition, the latest health updates in NWS have stated that there is still a significant increase in daily COVID-19 cases with a limited humanitarian response as of December 2022[14,15].

### *Antigen RDT Project Settings*

The Ag-RDT project was implemented between September and November 2022 in various camps, mobile clinics, and health facilities in three districts within NWS: Idleb, Afrin and Jarablus/Albab. An implementing partner organization, HiHFAD, was involved in implementing the Ag-RDTs within the districts of NWS. HiHFAD deployed 48 community health workers (CHWs) comprising 50% males and 50% females in 24 teams with additional 4 team leaders to oversee the implementation of 25,000 Ag-RDTs. All CHWs and team leaders underwent a two-day training on how to perform the Ag-RDTs. A context-specific algorithm consistent with WHO recommendations for low prevalence settings, as shown in **Figure 1**, was used to interpret the Ag-RDTs results.

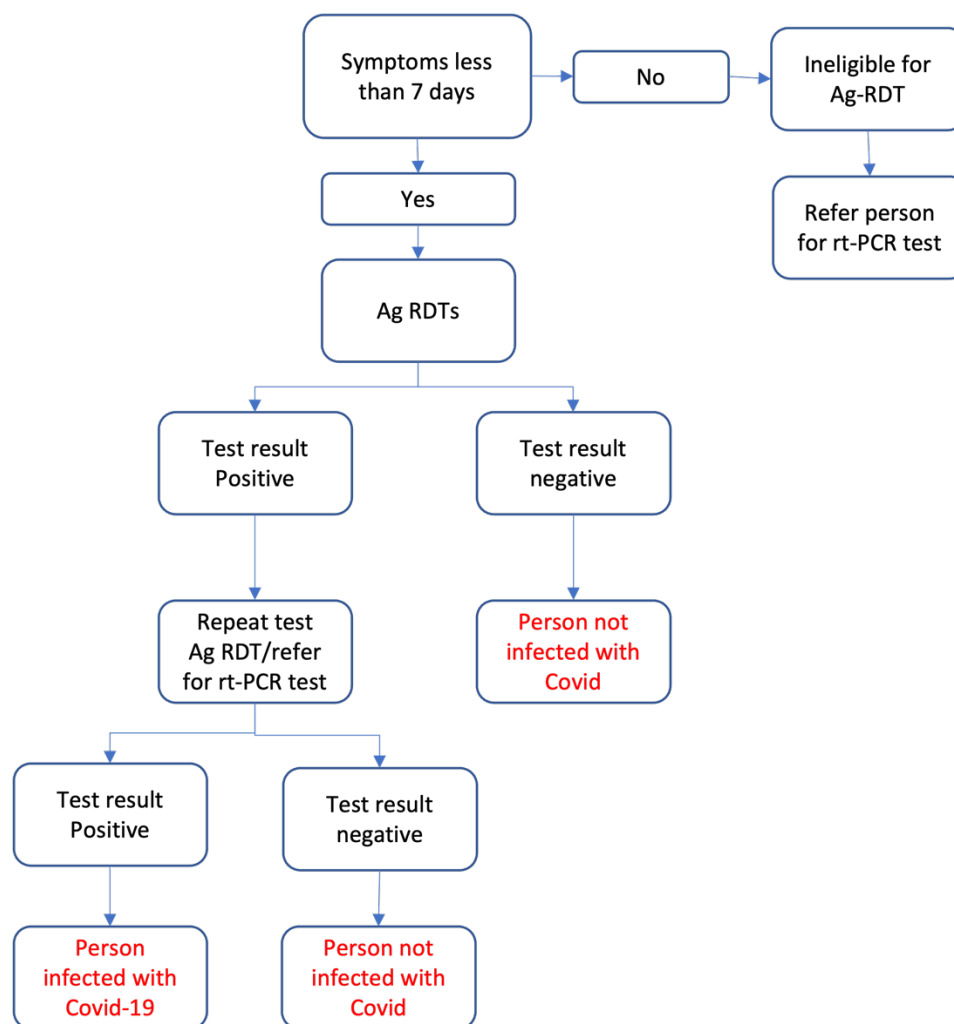


Figure 1: Algorithm used for antigen rapid diagnostic tests (Ag RDTs) in a pilot project in NWS.

#### Eligibility criteria

The persons from the target communities, who fulfilled any of the following conditions, were offered Ag-RDTs: a) patients presenting with COVID-19 symptoms to health facilities [primary health care centers (PHCs), hospitals and TB centers] within seven days of onset of symptoms; Symptomatic or asymptomatic persons who are: b) contacts of COVID-19 infected persons; c) internally displaced populations in dense areas; d) healthcare workers; e) other individuals who voluntarily sought COVID-19 tests. All persons who met the eligibility criteria were enrolled for Ag-RDT testing, and tests were conducted only when participants gave written consent.

#### Data recording and reporting

A recording and reporting system was designed to capture the demographic and clinical characteristics of the persons undergoing the Ag-RDT. The data were recorded initially in hard copies (logbooks). They were later entered into an online digital platform created in the KOBO Toolkit® to enable real-time monitoring of the project implementation.

#### Project supervision

To supervise and monitor the project implementation's activities, supervisory visits were made by the four project leaders, during which they interacted with both CHWs, and participants involved in performing or undergoing the Ag-RDTs. In addition, a supervisory visit by the project coordinator to the head offices of IOM and HiHFAD in Turkey included interviewing the team leaders and the

CHWs to discuss the faced progress and challenges. Detailed field visit reports were prepared and used for undertaking any corrective actions. In addition, the project coordinators also reviewed the data entered by the CHWs into the KOBO application weekly to assess gaps in the implementation, the data entered and provided feedback to address any deficiencies.

### *Study sample*

All persons eligible for the Ag-RDTs, regardless of age, have been included. The pilot project was implemented in NWS between September and November 2022. The pilot project enrolled 27,888 eligible to be offered the Ag-RDTs test.

### *Data variables*

For the first three objectives, the variables included the name of the health facility, date of enrolment, age, gender, presence or absence of symptoms, the reasons for Ag-RDTs testing, vaccination status, response to given consent, the results of Ag-RDTs test results and its date, presence, or absence of risk factors, and finally the results of rt-PCR testing and its date (if the person has undergone this confirmatory test). For the last objective, data gathered during the supervisory visits by the project coordinators were used to obtain information on the facilitators and barriers to the implementation and uptake of Ag-RDTs at the field level.

### *Data analysis and interpretation*

For describing the feasibility, uptake, and results of Ag-RDTs, the data on the demographic and clinical characteristics of the persons enrolled, those who consented to undergo the tests, and those with positive and negative test results were summarized as frequencies and percentages using R and R studio statistical software. Inferences on feasibility are based on the ease with which the CHWs could conduct the tests correctly in different health facilities and geographical areas as per the designed algorithm. These assumptions were based on the verbal confirmation of CHWs and were documented in the supervisory visits. Furthermore, inferences on the uptake of Ag-RDTs have been assessed by the number and proportion of eligible persons who gave consent to undergo the tests. Finally, for identifying the enablers and barriers to Ag-RDTs testing, we provided a narrative table of the lessons learnt and challenges encountered by CHWs in implementing the project as determined by the project coordinators.

### *Ethical issues*

This project was implemented after obtaining administrative approval from the Turkish directorates (Hatay and Gaziantep) responsible for implementing all health activities within NWS. Ethics approval was obtained from the IRB committee board of Rayak Hospital in Lebanon with a reference code: "ECO-R-35". Confidentiality of the data taken from the pilot project's recording system has been maintained. Consent was taken from all persons before the tests and for using their data for operational research. No names or identifying information of any person has been used in the analysis. Only aggregate data is being used to disseminate the study's results to all stakeholders.

## **3. Results**

Between September and early November 2022, 27,888 persons were found eligible to enrol on the project and were offered Ag-RDTs. The demographic and clinical characteristics of all enrolled participants, those who consented, and their Ag-RDTs' positivity rates are represented and were segregated by Gender and Age Group (**Table 1**), Reason for Testing, Vaccination Status, Duration, and Severity of Symptoms (**Table 2**), and by Testing Facility (**Table 3**).

**Table 1.** Demographic and clinical characteristics of people enrolled, consented for Ag-RDTs, and their positivity rates in a pilot project in NWS, segregated by Gender and Age Group.

Demographic and clinical characteristics	Participants		Consented for Ag-RDT		Positive among those who underwent Ag-RDT	
	N	(%)	N	(%)	N	(%)
<b>Totals</b>	<b>27888</b>	<b>100.0%</b>	<b>24956</b>	<b>89.5%</b>	<b>121</b>	<b>0.5%</b>
<b>Gender</b>						
Female	15913	57.1%	14474	90.3%	60	0.4%
Male	11959	42.9%	10467	86.7%	61	0.6%
Others	16	0.1%	15	93.8%	0	0.0%
<b>Age (in years)</b>						
<5	685	2.5%	557	81.3%	6	1.1%
5-17	2217	7.9%	2038	91.9%	21	1.0%
18-34	13569	48.7%	12087	89.1%	44	0.4%
35-49	7002	25.1%	6311	90.1%	34	0.5%
50-64	3338	12.0%	2999	89.8%	12	0.4%
>64	1077	3.9%	964	89.5%	4	0.4%

Overall, 24956 (89.5%) people have consented to undergo the test from the total 27,888 enrolled including 121 (0.5%) positive Ag-RDTs results.

The study population consisted of more females (57.1%) than males (42.9%), and approximately 74% were between the ages of 18 and 49. The consent to testing was relatively lower (86.7%) among males.

**Table 2.** Demographic and clinical characteristics of people enrolled, consented for Ag-RDTs, and their positivity rates in a pilot project in NWS, segregated by Reasons for Testing, vaccination status, Duration and Severity of Symptoms.

Demographic and clinical characteristics	Participants		Consented for Ag-RDT		Positive among those who underwent Ag-RDTs	
	N	(%)	N	(%)	N	(%)
<b>Totals</b>	<b>27888</b>	<b>100.0%</b>	<b>24956</b>	<b>89.5%</b>	<b>121</b>	<b>0.5%</b>
<b>Reasons for Testing*</b>						
Febrile illness	307	1.1%	288	93.8%	2	0.7%
Respiratory illness	198	0.7%	177	89.4%	4	2.3%
Others (Seeking assurance)	1095	3.9%	1087	99.3%	0	0.0%
Health care worker	731	2.6%	671	91.8%	13	1.9%
Is a refugee	12419	44.5%	10811	87.1%	10	0.1%
Is a migrant	29	0.1%	28	96.6%	0	0.0%
Has COVID-19 symptoms	12026	43.1%	11054	91.9%	97	0.9%
Contact with a COVID-19 infected person	1672	6.0%	1,393	83.3%	10	0.7%
Recently travelled	93	0.3%	90	96.8%	1	1.1%
Identified at TB clinics	123	0.4%	119	96.7%	0	0.0%
Admitted to ICU	307	1.1%	21	100.0%	0	0.0%
<b>Vaccination status</b>						
0 dose	17166	61.6%	15379	89.6%	79	0.5%

	one dose	4802	17.2%	4246	88.4%	15	0.4%
	two doses	4504	16.2%	4049	89.9%	18	0.4%
	more than two doses	1416	5.1%	1282	90.5%	9	0.7%
<b>Duration of symptom</b>		<b>N=12026**</b>	<b>(%)</b>	<b>N=11054§</b>	<b>(%)</b>		
	≤7 days	11890	98.9%	10928	91.9%	96	0.9%
	>7 days	136	1.1%	126	92.6%	1	0.8%
<b>Severity of symptoms</b>		<b>N=12026**</b>	<b>(%)</b>	<b>N=11054§</b>	<b>(%)</b>		
	Mild	11777	97.9%	10818	91.9%	67	0.6%

\*Multiple reasons possible, and therefore the total may add up to >100%

\*\*N here includes only enrolled participants with COVID-19 symptoms.

§: N here includes symptomatic participants who consented to undergo the Ag-RDTs test.

The main reasons for testing at the enrolment stage were being a refugee (44.5%) living within a high population dense area followed by having COVID-19 symptoms (43%). The highest positivity in those consented to test was observed among those with severe COVID-19 symptoms (12.7%), those with respiratory illnesses (2.5%), followed by healthcare workers (1.9%).

Among those who reported COVID-19 symptoms (N=12026), 98.9% reported the onset of symptoms within seven days or less, with 97.9% having mild symptoms.

About 61.6% of participants had not received a single dose of any COVID-19 vaccine.

**Table 3: Demographic and clinical characteristics of people enrolled, consented for Ag-RDTs, and their positivity rates in a pilot project in NWS, segregated by Testing Facility.**

Demographic and clinical characteristics	Participants		Consented for Ag-RDT		Positive among those who underwent Ag-RDT	
	N	(%)	N	(%)	N	(%)
<b>Totals</b>	<b>27888</b>	<b>100.0%</b>	<b>24956</b>	<b>89.5%</b>	<b>121</b>	<b>0.5%</b>
<b>Testing facility</b>						
Idleb - PHC	8732	31.3%	7435	85.1%	24	0.3%
Idleb - Hospital	8152	29.2%	6998	85.8%	38	0.5%
Idleb - Camps/mobile clinics	20	0.1%	16	80.0%	0	0.0%
Afrin - PHC	3845	13.8%	3438	89.4%	37	1.1%
Afrin - Hospital	278	1.0%	228	82.0%	5	2.5%
Afrin - Camps/mobile clinics	441	1.6%	433	98.2%	0	0.0%
Jarablus/Albab - PHC	3112	11.2%	3105	99.8%	7	0.2%
Jarablus/Albab - Hospital	2274	8.2%	2269	99.8%	9	0.4%
Jarablus/Albab - Camps/mobile clinics	1034	3.7%	1034	100.0%	1	0.1%

Footnotes: PHC=primary health centre; TB=Tuberculosis; ICU= intensive care units.

The majority (86.0%) of enrolments occurred at health facilities. The positivity rate among those consented to testing was highest at Afrin Hospitals (2.5%).

The demographic and clinical characteristics associated with those who consented to undergo the Ag-RDT tests are given in **Table 4**. In the bivariate analysis, males were less likely than females to consent to undergo Ag-RDT. Participants aged 5 to 17 were 1.35 times more likely to consent to the Ag-RDT than those aged 18 to 34. Most participants with a reason for testing, such as COVID-19-like symptoms, contacts with a confirmed covid patient, or recent travel, were more likely to agree to undergo RDTs than those without reason. However, participants' willingness to take the Ag-RDTs was significantly lower for IDPs in Northwest Syria than non-IDPs. Participants with severe COVID-19-like symptoms were 1.6 times more likely to agree to use Ag-RDTs than those with mild

symptoms. Consent rates were highest at Jarablus facilities, while participants from Idlib and Afrin health facilities and PHCs were less likely to consent to Ag-RDTs than at Jarablus.

**Table 4.** Demographic characteristics associated with consenting to undergo the Ag-RDTs in NWS.

Demographic and Clinical Characteristics	Bi-variable analysis		Multivariable analysis		
	OR	95% CI	Adj OR	95% CI	p-value
<b>Gender</b>					
Female	Ref		Ref		
Male	0.69	(0.645, 0.753)	0.78	(0.72, 0.84)	<0.001
Others	1.49	(0.3, 26.9)	0.97	(0.11, 8.18)	0.983
<b>Age group (in years)</b>					
<5	0.53	(0.43, 0.65)	0.62	(0.50, 0.77)	<0.001
5-17	1.39	(1.19, 1.64)	1.7	(1.43, 2.01)	<0.011
18-34	Ref		Ref		
35-49	1.11	(1.01, 1.23)	1.06	(0.96, 1.17)	0.209
50-64	1.08	(0.95, 1.23)	1.04	(0.91-1.18)	0.524
>64	1.04	(0.85, 1.28)	1.14	(0.42, 1.40)	0.204
<b>Reasons for testing</b>					
Has symptoms	1.6	(1.479, 1.738)	2.63	(1.94, 3.55)	<0.001
Contact with covid patient	1.6	(1.479, 1.738)	1.4	(1.00, 1.95)	0.045
Health care worker	1.32	(1.01, 1.72)	2.86	(1.94, 4.22)	<0.001
IDP	0.63	(0.58, 0.68)	2.32	(1.70, 3.15)	<0.001
Is a migrant	3.29	(0.44, 24.2)	2.92	(0.35, 23.9)	0.317
Identified at TB clinics	3.5	(1.29, 9.5)	12.27	(4.32, 34.8)	<0.001
Febrile Illness	1.79	(1.12, 2.85)	1.41	(0.78, 2.54)	0.243
Respiratory Illness	0.99	(0.63, 1.55)	1.55	(0.90, 2.65)	0.107
Recently travelled	3.53	(1.12, 11.17)	1.46	(0.41, 5.23)	0.559
<b>Vaccination status</b>					
0 dose	Ref				
one dose	0.88	(0.8, 0.98)	1.03	(0.93, 1.14)	0.564
two doses	1.03	(0.92, 1.15)	1.15	(1.02, 1.29)	0.016
more than two doses	1.11	(0.93, 1.34)	1.3	(1.07, 1.58)	0.006
<b>Testing district</b>					
Idlib	0.011	(0.006, 0.019)	0.008	(0.004, 0.016)	<0.001
Afrin	0.017	(0.009, 0.029)	0.015	(0.008, 0.027)	<0.001
Jarablus	Ref		Ref		

In the multivariate analysis, gender remained a significant predictor of consenting to the Ag-RDTs after considering potential confounders [OR= 0.69, 95% CI (0.645, 0.753)]. After controlling for confounders, we observed that younger ages (below 18 years old) are significantly associated with more chance to consent for taking Ag-RDTs compared to those aged 18-34 years. Health workers, refugees, and symptomatic individuals are more likely to agree to Ag-RDTs than others. A significant predictor of giving Ag-RDTs consent is the severity of symptoms, as they were 2.3 times more likely to consent for Ag-RDTs than people with mild symptoms.

Of those who underwent the Ag-RDTs, a non-random sample of 239 persons also underwent rt-PCR tests (**Table 5**). This included 72 of the 121 persons (59.5%) with positive Ag-RDT test results and 166 (6.7%) of the 24,811 persons with negative Ag-RDT test results.

**Table 5.** Comparison of Ag-RDTs and rt-PCR test results in those who have undergone both tests in NWS, 2022.

RDT test results	PCR test results			Total
	Positive	Negative	Not available	
Positive	<b>64</b>	<b>6</b>	2	72
Negative	<b>16</b>	<b>149</b>	1	166
Not available	0	1	0	1
Total	80	156	3	239

Of those who underwent the confirmatory rt-PCR test (n=239), the project team could not collect/receive information about the rt-PCR test results of 3 persons. Therefore, excluding these persons, a total of 236 persons had both Ag-RDTs and rt-PCR test results, as shown in **Table 5**. From this data of 236 persons, the observed sensitivity of Ag-RDTs was 80.0% [95% CI: (71.2% to 88.7%)] (64/80), specificity was 96.1% [95% CI (93%-99%)] (149/155), positive predictive value was 91.4% [95% CI (84.8%-97.9%)] (64/70) and negative predictive value was 90.3% [95%CI (85.7%- 94.8%)] (149/165).

The reported challenges and facilitators encountered during project implementation are listed in **Tables 6** and **7**. The key challenges were obtaining informed consent, referral for confirmatory rt-PCR testing and recording and reporting the data under the project.

**Table 6.** Challenges encountered during the Ag-RDTs pilot project in NWS.

Domain	Challenge/s
Identification of eligible population	No major challenges were detected.
Obtaining informed consent	The most common reason for refusing the test was fear of pain and discomfort from a previous unpleasant experience in taking the test, followed by the belief that COVID is over. The other possible reasons are conspiracy theories, fear of isolation and stigma.
Conducting the test	No major challenges were detected.
Acceptability of positive/negative results	No major challenges were detected.
Referral for rt-PCR testing	Only a small number of PCRs were performed in coordination with the representing local NGO for Covid rt-PCRs as current policies in NWS have restricted the overall usage of Covid PCRs due to low prevalence at that time.
Supply chain management issues of antigen RDTs or ancillary items	No major challenges were detected.
Recording and reporting	This was done through mobile phones, which was challenging, especially during data cleaning. Using laptops was a more convenient choice.
Mobility	Initially, it was challenging for CHWs to move to implementing sites. However, this challenge was mitigated by the implementing partner by scheduling rides from their operating mobile cars fleet.

**Table 7.** Facilitators that contributed to the good feasibility and uptake of Ag-RDTs in NWS.

Domain	Facilitators
Overall positive perceptions from the NWS community to Ag-RDTs compared to PCRs and other tests.	<ul style="list-style-type: none"> <li>Ag-RDTs yield the results in a few minutes, giving the participants rapid assurance about their health status.</li> <li>The RDTs are done on-site, so there is no need to travel to laboratories to undergo the tests.</li> </ul>
Engagement of CHW with previous experience in COVID response.	<ul style="list-style-type: none"> <li>The implementing partner involved CHWs with previous experience in COVID response in NWS, which eased the implementation process under the Ag-RDTs project.</li> </ul>
Convenience in performing confirmatory PCRs when possible.	<ul style="list-style-type: none"> <li>The implementing partner, HiHFAD, did some free-of-charge confirmatory PCR tests in coordination with a local NGO in NWS.</li> <li>Ag-RDTs and PCRs samples were collected on the spot for each participant in the presence of workers from both organizations, mitigating the financial and mobility challenges displaced populations in NWS face when undergoing laboratory tests.</li> </ul>
The common culture between health workers and participants	<ul style="list-style-type: none"> <li>A shared culture between health workers and participants made it easier for participants to trust and accept the Ag-RDTs implementation process and the test results.</li> </ul>
Increasing the motivation of participants to take the Ag-RDTs.	<ul style="list-style-type: none"> <li>This was done through on-the-spot educational and awareness sessions during the RDTs implementation.</li> </ul>

#### 4. Discussion

This is one of the first studies from NWS describing the use of COVID-19 Ag-RDTs in a piloting project. The study showed the following.

First, people eligible for Ag-RDTs testing were reached out to fulfil the project's Ag-RDTs targeted quota within a very short 2-month implementation period. The wide variations seen in the numbers enrolled at the nine different sites are due to the differences in the population distribution in these geographical areas. The enrollment at PHCs and hospitals was higher than at the camps/mobile clinics since all health facilities and hospitals in NWS are distributed inside the camps. As reported by the implementing partner, only a few camps lack these facilities. All the selected nine facilities had successfully deployed all their Ag-RDTs, indicating good feasibility of using these tests at all sites within NWS through CHWs. Also, interviewing the CHWs during supervisory visits did not reveal any major challenges in performing/deploying these tests, adding to the global evidence on the feasibility of rapid deployment of Ag-RDTs to inform necessary control and care measures in all settings[16,17]

Second, the uptake of Ag-RDTs was nearly 90%. This was mainly due to the positive communication by the CHWs about the advantages and need for undergoing Ag-RDTs to ensure there is no break in COVID-19 surveillance. This communication enabled positive perceptions about the Ag-RDTs and facilitated their uptake. The uptake was relatively higher among those with COVID-19 symptoms, healthcare workers, refugees, those who had received more than two or more doses of vaccination, and those identified at TB clinics. Previous studies show good overall uptake of Ag-RDTs from different populations, especially among symptomatic[18,19]. The reasons for the lower uptake of Ag-RDTs among those aged less than 18 years and among those identified at Idleb and Afrin districts could not be identified through CHWs interviews in the supervisory visits. This is an area that needs further investigation through qualitative research methods.

Third, the overall positivity rate within our sample was very low (0.5%), indicating low infection prevalence levels at the community level. The highest positivity was observed among those with severe COVID-19 symptoms (12.7%), those with respiratory illnesses (2.5%), and participants enrolled at Afrin Hospitals (2.5%), followed by healthcare workers (1.9%). These findings, on the one hand, indicate the high-risk groups who should be targeted for COVID-19 testing in these low

prevalence/transmission settings. On the other hand, these findings also suggest that some geographical regions/pockets with persisting COVID-19 infection can flare up COVID-19 transmission if there is a new mutant of the virus. Therefore, continuous surveillance will be needed. The data on positivity rates among different participants' characteristics can play an essential role in surveillance activities, especially to screen-in and diagnose COVID-19 infection in these high-risk groups.

Fourth, a formal assessment of the sensitivity and specificity of the Ag-RDTs at the field level could not be done due to challenges in identifying an academic partner in this setting. Nevertheless, we could estimate sensitivity and specificity in a non-random sample of persons undergoing Ag-RDTs and rt-PCR tests. The observed sensitivity of 80.0% (95% CI: 71.2% to 88.7%), specificity of 96.1% [95% CI (93%-99%)], the positive predictive value of 91.4% [95% CI (84.8%-97.9%)] (64/70) and negative predictive value of 90.3% [95%CI (85.7%- 94.8%)] (149/165) observed in this study were in line with other studies reviewing the accuracy of the same Ag-RDTs type as used in our pilot project[20,21]. The relatively less observed sensitivity and negative predictive values in this pilot project than the manufacturer-reported values could be due to the quality of the nasopharyngeal samples collected and the appropriate processing of collected samples and reagents in the test kits [22–26].

Such deficiencies must be identified and rectified through training and supportive supervision in future projects. In addition, considering the high specificity (96.1%) and good negative predictive value (90.3%), screening-out persons as free of COVID-19 based on the Ag-RDTs results would be a reasonable approach in this setting whether a confirmatory PCR test followed it or not.

Fifth, Confirmatory rt-PCR tests could be conducted (per the algorithm) in only 60% of those with positive Ag-RDT tests. This indicates operational challenges in following the complete algorithm needed for optimal deployment of Ag-RDTs. This observation was similarly observed in other related studies evaluating Ag-RDTs implementation [27,28]. Therefore, there is a need to enhance both the capacity and accessibility of rt-PCR within the health system catering to these populations. If not, the clinical and public health actions on COVID-19 infection/transmission will have to be based on Ag-RDTs alone.

Finally, 61.6% of our sample have reported they did not receive a single COVID-19 vaccine dose. The reported percentage of people in NWS who have not received a single COVID-19 vaccine dose during our implementation period as per the WHO was 86.4%[29] showing significant global inequities in vaccination coverage in these populations.

### **Strengths and limitations**

The major strength of this study is that it was done using data from the pilot project implemented under routine programmatic conditions using the existing health service delivery mechanisms. Therefore, the study findings on feasibility, uptake, Ag-RDT performance and positivity rates likely reflect ground-level realities. The study's major limitations are: First, the project was conducted in a low prevalence/transmission setting. Therefore, the results may not be replicable if there is a flare in the COVID-19 prevalence. Second, the implementation challenges and facilitators' data were collected during routine supervision visits. As a result, the information provided by CHWs may be biased if they have failed or were uncomfortable reporting any critical issues to their supervisors. Third, due to challenges/restrictions in meeting the community members, their perspectives about the feasibility and acceptability of Ag-RDTs could not be fully captured. This is an area for future research.

### **5. Conclusions**

This pilot project in NWS demonstrated that using Ag-RDTs as a screening/diagnostic tool through CHWs for COVID-19 infections is feasible. The data on uptake and positivity rates indicates

that Ag-RDTs can be targeted to health facilities, people with respiratory, febrile, or COVID-19 symptoms, contacts of COVID-19 patients and health workers. The project also highlights the need for a thorough strategy to independently use Ag-RDTs results in screening in/out of COVID-19 infections among refugees and IDP settings. Finally, continuous surveillance and enhancement of COVID-19 vaccination coverage are needed.

**Supplementary Materials: Document S1:** Written Consent Form – English (Arabic Translation is Available)

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**Data Availability Statement:** The clean set of raw data presented in this study are available on request from the corresponding author in MS Excel. The data are not publicly available due to data protection and privacy policies following the UN Migration Agency (IOM) standards.

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