

This document walks through feedback loops and dynamics described by the Understanding Social Determinants of Testing and Vaccination Workgroup within RADx-UP between February 2022 and February 2023 believed to be most important in shaping COVID testing in US communities. The group focused on the critical role of social determinants of health that impact COVID-19 testing.

Symbols Key

- = a change in the starting variable (before the arrow) triggers a change in the connected variable (where the arrow is pointing to)
- S → = same relationship (as one goes up or down, so does the other)
- O → = opposite relationship (as one goes up, the other goes down; as one goes down, the other goes up)
- R = Reinforcing; a feedback loop where changes are reinforced over time, leading to exponential increases or decreases in connected variables
- B = Balancing; a feedback loop where changes are counteracted or balanced over time

Visualization of Loop and Related Structure

Here, the segment of the larger causal loop diagram being described in the row is presented.

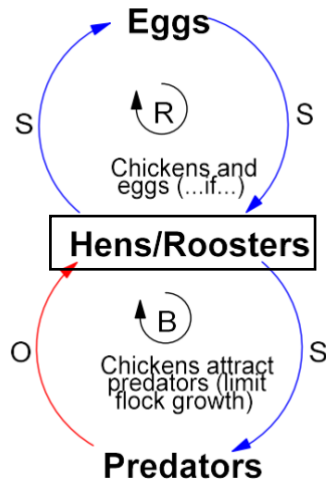
Explanation of Structure

This section explains the loop structure in lay terms.

Resources / Quotes

Quotes can bring the loop to life – they represent how stakeholders talked about this loop structure in their community. Resources can help you plan action.

Example Feedback Loops



**EXAMPLE
NOT RELATED TO COVID**

An increase in hens and roosters triggers an increase in the number of eggs laid. Some of these eggs hatch, increasing the number of hens and roosters. This loop describes the population growth of hens/roosters.

Whereas the loop above was an engine of growth, this second loop is a limit to growth in the chicken population. An increasing number of chickens attracts predators, which then will prey on them and limit population growth until the flock is no longer desirable (allowing the population to recover).

A feedback loop is created when a chain of causal linkages circles around to affect a variable earlier in the loop -- over time -- closing the loop. A reinforcing loop (indicated with an "R" in the middle of the loop) illustrates a feedback loop where changes are reinforced over time, leading to exponential increases or decreases in connected variables.

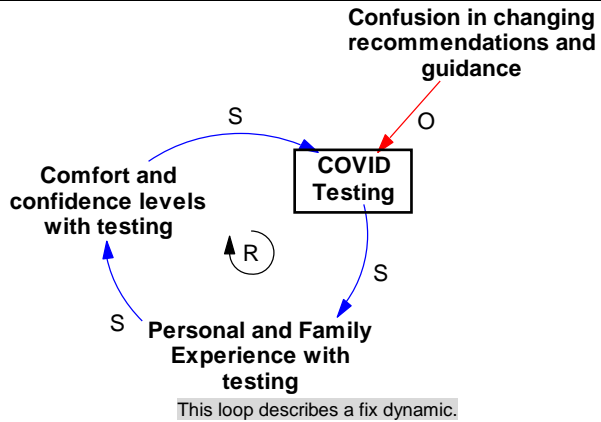
A balancing loop (indicated with a "B" in the middle of the loop) illustrates a feedback loop where changes are counteracted or balanced over time.

An "S" on the arrow (along with blue color) indicates that the two connected variables move in the same direction (i.e., if the first variable increases in size/quantity/etc., the second variable also increases. And, if the first variable decreases, the connected variable decreases).

An "O" on the arrow (along with red color) indicates that the two variables move in opposite directions (i.e., if the first variable increases in size/quantity/etc., the connected variable decreases; if the first variable decreases, then the connected variable increases).

Drawing Causal Loop Diagrams:
<https://thesystemsthinker.com/pocket-guide-guidelines-for-drawing-causal-loop-diagrams/>

Feedback loop A – Reinforcing – “Experience enhances testing uptake”



Explanation of Structure

As there is an increase in COVID testing, individuals become more experienced and familiar with it (themselves, their family, friends, etc), increasing their own comfort and confidence with testing. This will increase testing uptake, all else equal.

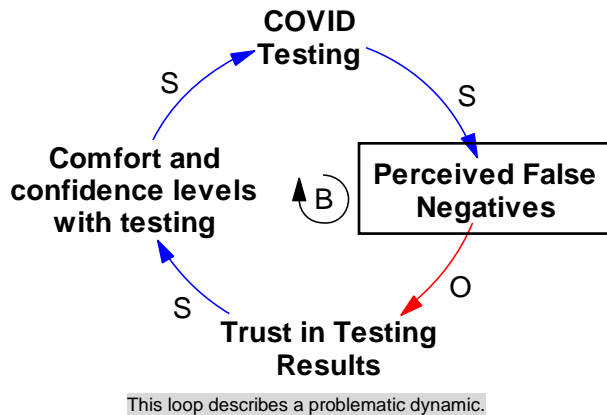
If test use is not growing in a vulnerable population, community health workers (trusted peers) can help! (See community quote at right.)

However, not all else is equal. One important factor to note is that as recommendations and guidelines change (e.g., triggered by scientific advances or a changing COVID context), it's confusing! This confusion in changing recommendations and guidance negatively affects COVID testing uptake.

Resources / Quotes

One community partner shared that “In the beginning, testing was taboo.” Through efforts such as community health workers outreach, increased comfort was able to increase the willingness to take a COVID test.

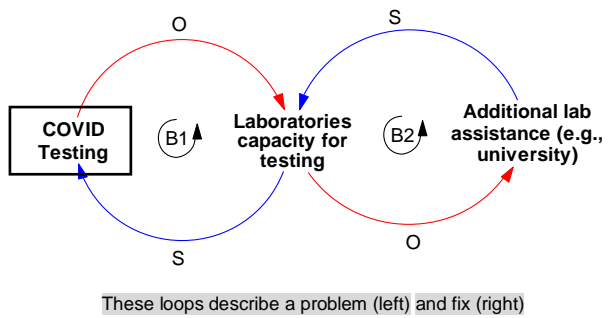
Feedback loop B – Balancing – “Perceived false negatives decrease trust and testing behavior”



Explanation of Structure

In the heat of a COVID spike, rapid antigen tests, in particular, can result in false negatives. When this happens, it eats into trust in testing results, confidence in testing, and ultimately, whether people test. This might even happen when someone thinks they have COVID (e.g., have consistent symptoms), but tests negative. With time, negative perceptions about testing can fade. But from spike to spike, we should try to counteract any misperceptions about testing.

Feedback structure C – Balancing – “Necessity of additional laboratory assistance due to limited capacity”



Explanation of Structure

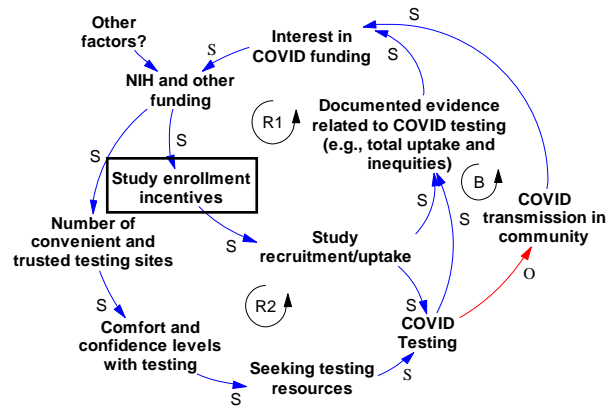
B1 - Increased testing can limit laboratories capacity for testing. Also, if there is limited capacity then we can only perform a limited amount of covid testing.

B2 - Additional lab assistance such as from universities can increase testing capacity temporarily -- when need spikes.

When resources become limited, care must be taken to ensure that temporary fixes are accessible to the most vulnerable subpopulations or inequities will grow.

These loops describe a problem (left) and fix (right)

Feedback structure D1 – Reinforcing & Balancing – “Funding supports testing but needs to be adequate and sustained”



Explanation of Structure

R1 - Study enrollment incentives (through research or other programs) will increase study enrollment/uptake, which will increase evidence related to COVID testing. This evidence demonstrates that the funded agencies can succeed in increasing testing access, which increases their future fundability. Evidence might also highlight testing inequities that need to be addressed through further funding.

It is important, though, that when new programs or sites are funded, they should be adequately resourced to succeed in their recruitment, data collection, and other goals for which they were funded. For example, if tests are provided, but without adequate incentives or culturally appropriate resources, the program will not meet its goal and will struggle to provide needed services to vulnerable populations in the future (e.g., threatened relationship with funders). This is a real threat to providing testing to the most medically underserved populations.

R2 - As data for covid testing uptake becomes available and reported to NIH and other funding agencies, they can assess disparities in testing uptake and fund programs to increase overall and equitable testing, such as increasing the number of convenient testing sites in the community and providing study enrollment incentives that can increase participation in testing.

B - We have to be careful, though, not to stop these programs too soon, as testing (and vaccination) will reduce COVID transmission in community (but in some populations faster than others). If we're cutting programs that allow testing in high-need populations (e.g., reducing the number of convenient and trusted testing sites), we may not appreciate the continued need (e.g., high test-positivity) in the vulnerable subpopulation served. Some supports (e.g., community health workers) put in place to support COVID addressed other health needs (e.g., see loop G below).

Data demonstrating where testing needs to be scaled up is a critical factor in directing limited resources (e.g., public funding, research funding). But factors beyond data impact funding, and it's not always clear to programs who support testing among the medically underserved what those factors are. Can we improve how resources supporting testing are disseminated?

Resources / Quotes

The motivations for enrolling in a study have changed over the course of RADxUP's funding. As one work group member shared, "This is all very time dependent; dynamics of COVID-19 have been changing frequently over the past three years." By mid 2022, the reality was, as they said, "People are over it [COVID testing]". When initially in late 2020 people may have joined a research study in order to access tests, a work group member shared that, "People are not joining our study for the benefit of getting tested... it may have been like that two years ago... they are currently joining a study despite the fact that it would require testing... it's something they're gonna put up with and participate in the study for other reasons"

When considering funding for underserved communities, a work group member shared that "DEI is a buzzword" and can be a major driver of funding right now. There is a current focus on health disparity, particularly in their prioritized community of Black and Brown people with underlying conditions at higher risk for

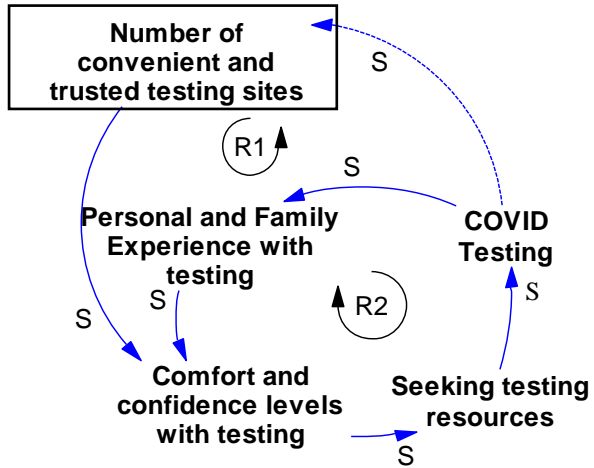
Also, we need to be aware that while the extent of testing needs change with COVID spikes and periods of low transmission, the need for maintaining trust and resources in the community always remains. Should trusted resources be cut they can be hard to re-establish quickly in the face of a new spike

COVID-19 symptoms or mortality.

When speaking to the concern of NIH funding sustainability, one work group member said, "We may collect strong data...this in and of itself does not guarantee that there will be more funding for COVID-19 testing research."

Feedback structure D2 – Reinforcing – “Testing site adequacy supports adequate testing”

Explanation of Structure



R1 - As there are more convenient, accessible testing sites, individuals are more comfortable and confident with testing, increasing their testing uptake. But the inverse is also true, and lack of access is a real trigger for disparities in testing (which lead to disparities in COVID).

R2- As individuals and their families have positive experience with testing, they feel more comfortable and confident with testing, increasing overall testing uptake.

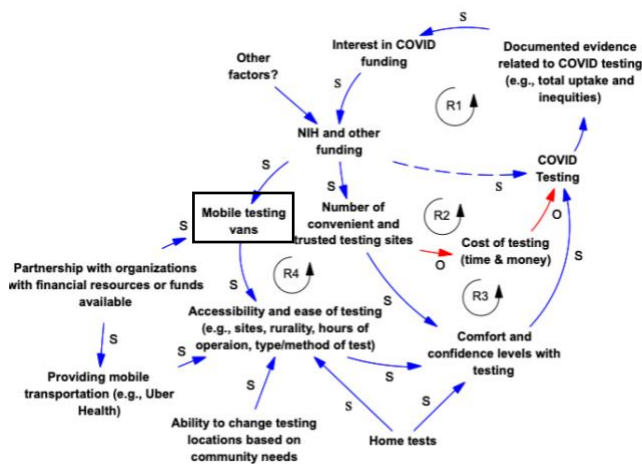
The dotted/dashed line in this diagram indicates that other variables are in between the two variables, but we are summarizing this linkage to focus on the key variables in this loop.

These loops describe a fix dynamic.

Feedback loop E – Reinforcing – “Benefits of having convenient testing sites and mobile testing vans”

Explanation of Structure

Resources / Quotes



Mobile testing vans were one of the RADx-UP programs' testing innovation efforts to increase testing access, particularly in rural areas and sites where clinics' limited hours of operation limited access to testing. Not only did they increase access, which triggered more comfort and confidence with testing in populations served, but the increased testing and data demonstrated the strength of this approach (and reinforced it).

One work group member let us know that county funds have been supplied to partner with CBOs to provide additional funding ; and/or county health department has provided funds to increase access.

Home tests are another convenient way of getting tested.

“DHHR supported testing expansion as part of our project in order to reach more places when the demand was so high.”

When testing sites have limited hours of operation such as clinics, the ability to change testing locations based on community needs (such as from clinics to churches) could increase testing access and uptake.

Universities and other schools have also increased community testing by providing testing for students faculty and staff.

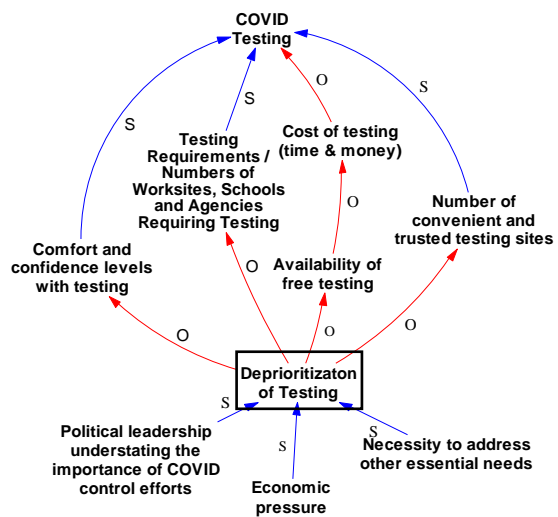
The programs' one effort to confront limited, insufficient funds was having partnership with organizations that have financial resources who can fund providing mobile testing vans or mobile transportations (such as Uber Health) to increase testing access.

The dotted/dashed line in this diagram indicates that other variables are in between the two variables, but we are summarizing this linkage to focus on the key variables in this loop.

“Local San Diego Foundations have funded CBO's to provide increase testing and vaccinations in communities of color”

These loops describe a fix dynamic.

Not a feedback loop but important pathways affecting COVID testing (Pathways 1) – “De-prioritization of testing”



Explanation of Structure

There are many reasons that lead to de-prioritization of testing such as political leadership understating the importance of COVID control efforts, economic pressure, and addressing other priorities or needs during the pandemic such as food and transportation over testing.

De-prioritization of testing for different reasons (i.e., making it less important) negatively impacts covid testing uptake by decreasing testing requirements, making individuals feel less comfortable or confident with getting tested, decreasing availability of free testing, and decreasing the number of convenient and trusted testing sites.

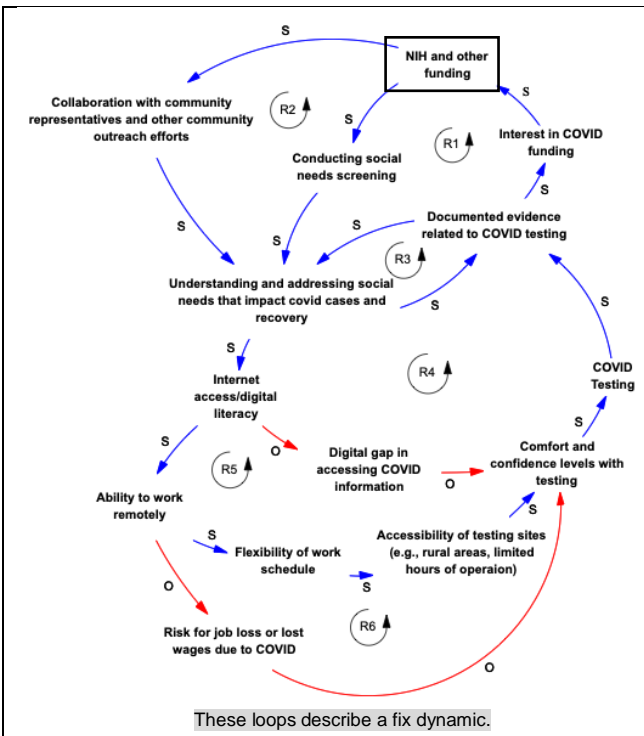
Specifically with the loss of free testing, testing sites are often only able to provide tests for people with health insurance or who can pay the cost out of pocket. This has huge impacts on who can afford to get tested.

Resources / Quotes

[depolarization of testing]
 "Schools in Florida...you don't have to get tested to go back to school. So those political mandates affect testing all the way, and the trust that people have in the test."

These pathways describe a problematic dynamic.

Feedback loop F -- Reinforcing -- "Example of understanding and addressing social needs -- Benefits of digital inclusion/equity"



These loops describe a fix dynamic.

Explanation of Structure

R1/R2/R3 - Several other ways RADx-UP projects worked to increase testing access and uptake were conducting social needs screening, collaborating with community representatives, and community outreach to help understand and address social needs that impact COVID cases and recovery via data collection.

R4 - One of many ways understanding and addressing social needs can increase testing access is through closing the digital divide/gap, which affects accessing covid-related information and resources.

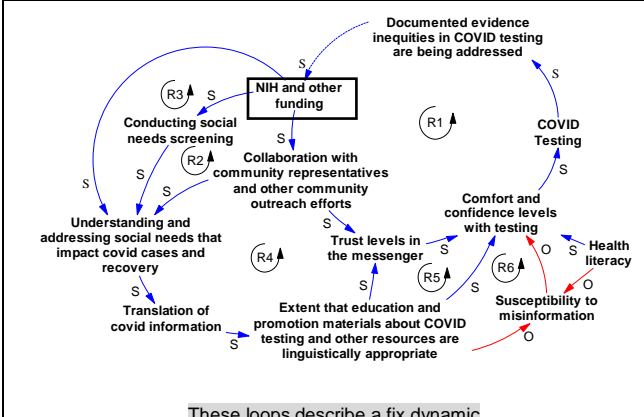
R5 - Having internet access at home allows working remotely, which allows having more flexible work schedules to get tested when needed and lower pressure from the risk of job loss or lost wages due to COVID, which overall can increase testing uptake.

R6 - Essential/frontline workers do not generally have the ability to work remotely which increase their testing hesitancy and negatively impact their testing uptake while they are usually at high risk of COVID exposure and infection and require testing more frequently.

Resources / Quotes

[Social and network of support]
 "In our program I remember at the beginning of the pandemic one thing we did, we made sure we always had an outreach team to communicate with the households. One of our households I remember she was infected and the outreach workers were there for the family. We even had a food pantry where we brought food to them at their home...so they had their food insecurity met [so they did not have to leave the house when potentially infectious]."

Feedback loop G – Reinforcing – “Example of understanding and addressing social needs – Benefits of linguistically appropriate resources dissemination”



These loops describe a fix dynamic

Explanation of Structure

R1/R2/R3 - As NIH and other funding increases, agencies are more able to conduct social needs screening, and collaborate on community outreach efforts. These efforts increase understanding and ability to address social needs.

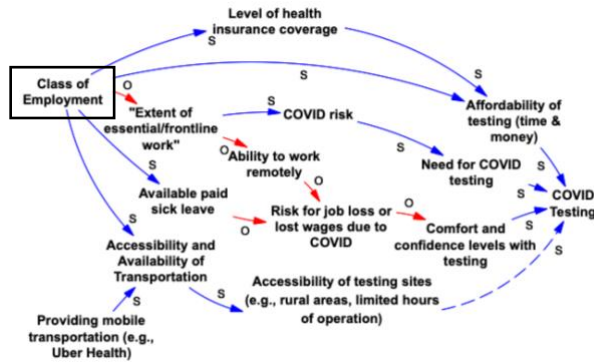
R4/R5 - One of the social needs involves translation (meaning into multiple languages as well as culturally and linguistically appropriateness), which improves understanding of COVID information, trust in messengers, and ultimately, comfort and confidence levels with testing. Any improvements in understanding of COVID information decrease susceptibility to misinformation.

Health literacy impact both individuals' susceptibility to misinformation and comfort/confidence levels with testing.

Not a feedback loop but important pathways affecting COVID testing (Pathways 2) – “Employment Factors that Influence Testing”

Explanation of Structure

This visualization explains a series of pathways.



These pathways describe a fix and problematic dynamic

Being employed, and the class of employment, has many influences over social determinants of health that in turn influence ability to take a COVID test. As employment benefits and income increase according to the class of employment (i.e., full-time vs part-time, unionized vs ununionized, documented vs undocumented), level of insurance coverage increases, which increases the ability to afford (in both time and money) getting a COVID test.

As employment benefits and income decrease, there is an increased likelihood of essential/frontline work, and as essential/frontline work increases, workers risk of COVID exposure increases, and their ability to work remotely decreases, and their availability of paid sick leave decreases (or is nonexistent).

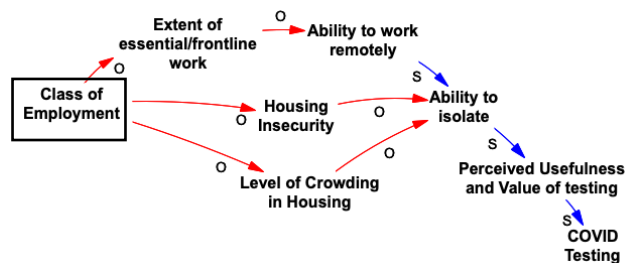
As available paid sick leave from work decreases (to smaller amounts or to none), the risk of job loss or lost wages due to COVID or even accessing a COVID test increases. This decreases comfort and confidence with taking a COVID test, as it has real implications for further income or employment, and will decrease COVID testing.

As COVID exposure risk increases, the need for testing increases, and in theory this should increase COVID testing. However, the other employment factors may complicate this. As ability to work remotely decreases, there is an increased risk of job loss or lost wages due to COVID (for example, working from home while sick is uncomfortable but often still possible, whereas in frontline work you may be required to quarantine from co-workers). As risk of job loss or lost wages increases, there is a decrease in comfort and confidence with taking a COVID test, and therefore decreased COVID testing.

As accessibility and availability of transportation decreases, the accessibility and accommodation of testing sites decreases which will decrease COVID testing.

The dotted/dashed line in this diagram indicates that other variables are in between the two variables, but we are summarizing this linkage to focus on the key variables in this loop.

Not a feedback loop but important pathways affecting COVID testing (Pathways 3) – “Isolation Challenges: ‘Why would you even test?’”

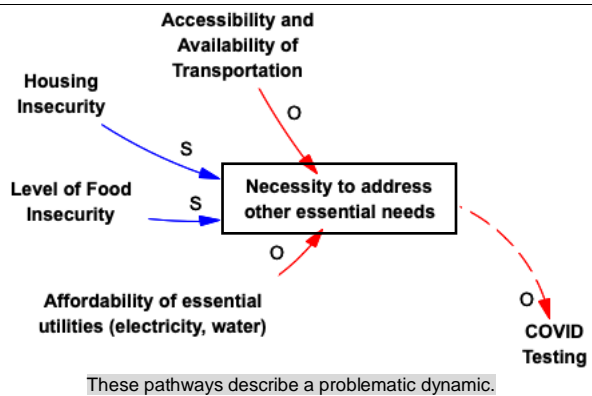


These pathways describe a problematic dynamic

Explanation of Structure

Being employed and the class of employment may impact one's ability to isolate through several pathways, which ultimately will impact the perceived usefulness and value of testing. For example, as employment and income decreases, the risk of housing insecurity and the extent of crowding one has in their housing situation increases, which decreases the ability to isolate. Also, as employment and class of employment decreases, the likelihood that one is engaged in essential/frontline work increases, which decreases ability to work remotely and decreases the ability to isolate. If someone has limited ability to isolate, the perceived and actual utility of testing is lowered, which results in lower COVID testing.

Not a feedback loop but important pathways affecting COVID testing (Pathways 4) – “COVID is a lesser survival priority”

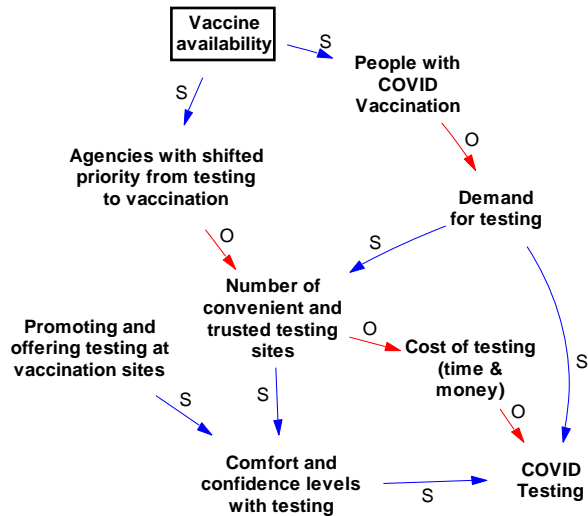


These pathways describe a problematic dynamic.

As individuals have greater pressing needs to address other essential needs, they may de-prioritize getting tested. Examples of other essential needs include having accessible and available transportation, housing security, food security, and the ability to afford essential utilities such as electricity and water.

The dotted/dashed line in this diagram indicates that other variables are in between the two variables, but we are summarizing this linkage to focus on the key variables in this loop.

Not a feedback loop but important pathways affecting COVID testing (Pathways 5) – “Shifted Priority from Testing to Vaccination”



These pathways describe a problematic dynamic.

Explanation of Structure

As vaccines become available, many agencies and communities have shifted their priorities from testing to vaccination and more people become vaccinated. Increase in vaccination decreased demand for testing which decreased the number of testing sites and thereby lowered testing uptake.

Programs' suggestions to counteract this shifted priority affecting testing uptake was to promote and offer testing at vaccination sites which can increase convenience and confidence levels with testing.

Resources / Quotes

We heard from community members that once vaccinations became available, the interest in testing decreased. The only way to bring people in for COVID-19 testing was to offer that they could also get a vaccine at the same time.

