00:06 Sarah Crespi: Welcome to the Science Podcast for August 14, 2020. I'm Sarah Crespi. First up this week, staff writer Robert Service talks about a different approach to COVID-19 testing that might be useful in response to the high number of cases in the US. Next we have researcher Salma Mousa. We talk about her experiment that looks at how social contact between Christians and Muslims on soccer teams in Northern Iraq could have an effect on tolerance.

00:36 SC: First up this week, we have staff writer Robert Service, he's going to talk about rapid coronavirus testing. Hi, Bob.

00:42 Robert Service: Hi, Sarah.

00:44 SC: You write about rapid testing this week, because even though we've ramped up from maybe 100,000 tests per week in March to now 5 million per week, this is all in the US, there's still a lot of lag in when people get results, and we're seeing a lot of uncontrolled spread. How would a new strategy based on rapid testing work?

01:08 RS: The problem there is, is that the whole testing scheme using a diagnostic test is just not really addressing one of the key questions of the current pandemic, and that question is not so much, do I as a patient, am I sick today or not from this disease, but the question is more of a public health question, it's where is this disease in our community, who has it, who doesn't have it, and can we identify people quickly in order to get them to self-isolate and that way break the chain of transmission of the coronavirus.

01:45 SC: So if you're coming at this from a public health angle, why is it important for the test to turn around rapidly?

01:52 RS: The speed with which you can give and get a result back turns out to be the most important factor in reducing the transmission of a virus in the community. If you get a test and get the result within 15 minutes or a half an hour, if you get a positive result, you can take yourself out of circulation, not go to the grocery store, not go to your friends' barbecue or whatever, and that in a community will begin to lower the transmission of the virus pretty quickly.

02:15 SC: What are the differences between a rapid test like you describe and the diagnostic PCR tests that we started talking about?

02:25 RS: There are a couple of different classes of these rapid tests. One class of them uses an approach that's pretty similar to PCR, they do some of the steps differently or skip some of the steps, and most of those have a sensitivity that's quite high, so they can still be used as diagnostics. And one example I think that we're probably all familiar with is that the White House uses a rapid PCR test called the Abbott ID NOW test. So that's great for the White House, and it would be fantastic if we could all get such a rapid test. The problem is, is that those aren't available on the scale of hundreds of millions of people, but there are other tests that could be. There are tests called
antigen tests that work very differently, they test for the viral proteins.

03:10 RS: These tests are what people might think of like a pregnancy test, where it's just a simple yes/no answer, there's not a whole lot of extra machinery involved, so they can be really cheap, you can make them by the millions, potentially tens of millions, hundreds of millions, and so then you can begin to think of designing a test system that's very different.

03:28 SC: How cheap are these tests, the antigen tests or the rapid PCR tests?

03:34 RS: PCR tests in general can be around $100 or more, the rapid PCR tests can be down to $20, and hopes of maybe using pooled strategies or something like that, you could drive it down possibly even to $10 a test. That's starting to get pretty good. The antigen test can be made for as little as a buck or two, so they're really quite cheap. Then it becomes possible as a national strategy to begin thinking about giving these to everybody.

04:00 SC: PCR has an amplification step where it looks for a piece of RNA and then it makes a bunch of copies of it, so the signal is strong, whereas an antigen test, it's looking for a scrap of protein, and it might be easier to miss someone who is positive, but the sample just didn't capture that.

04:19 RS: The antigen test doesn't amplify anything. Because it's not amplifying anything, it's not as sensitive, it tends to miss very low levels of the virus. But what I think a lot of epidemiologists are coming to around the idea of is that might not be such a bad thing, because in the case of this novel coronavirus, what happens when people get infected is their body in the first couple of days starts to produce more and more virus, and then it goes up really rapidly, then it plateaus at some point and then comes down on this long tail, and then it kinda stretches out for a long time where people can have low levels of the virus for a very long time.

05:00 RS: And the problem is, is the PCR machines can pick that up and say, hey, you've got this coronavirus genetic material, you might be positive. Well, you know, they might only infect others there when they're really cranking out their large amount of virus, and that's what most epidemiologists think today. So the antigen tests, though, they are less sensitive than the PCR test, they're flagging people who are at risk of being most infective, which is from a public health standpoint, that's exactly the people you want to identify.

05:31 SC: And if you have a strategy that focuses on rapid testing of a broad swath of the public, you're also going to want to do it multiple times, and so you might pick up somebody if an antigen test missed them, the next time they take a test.

05:46 RS: Well, that is absolutely the key. So that's one of the other things that is being recommended, you don't just give people one antigen test and call it good, you would give them a whole batch and say, hey, test yourself every three days. Even if you have a test with 70% accuracy or sensitivity you might miss 30% of the people on that first test, but then you're going to pick up 70% of those 30% on the second test, and on and on and on, and so you're going to pretty quickly catch up. Part of the way to think about that is the PCR tests are just missing these people
altogether, 'cause they're not even testing huge loss of asymptomatic people, because they're just saying, well, we only have enough tests to go around for the symptomatic people. They're letting all those go right by, and so the virus continues to transmit through all those people, which is why there's become this huge debate about mass and trying to find other ways to contain the virus.

06:36 SC: So rapid testing actually goes along with the idea of testing many, many people, not just those who maybe came in contact with someone with COVID-19 exposure or someone who's showing symptoms.

06:49 RS: That's right, so the conventional approach to diagnostic testing for coronavirus the way we've been doing it, is that you test people with symptoms or who for some reason think they have an exposure, and then if they're positive, you get them treatment or get them out of circulation. Because the coronavirus is now so widespread in American communities, that approach is not really viable right now. Let's give an example of a school. So if you have a school that wants to reopen, you give every student and every teacher and administrator a test twice or three times a week for many weeks going forward, and that way anybody who becomes positive along that line can self-isolate very quickly, and you don't get sustained transmission. What you need for this kind of an approach are cheap tests, fast tests and repeated tests.

07:44 SC: In your story, you give a few examples on the scale of a university and then also on the scale of the entire country for how this might work. Can you talk about the university example that you give?

07:54 RS: There was a paper that came out from Yale University, in which they modeled what it would take to do this kind of testing for a hypothetical university of 5000 people, and they said, okay, let's begin with the assumption that 10 people are positive, but we don't know yet. What's going to happen if we don't do any tests, if we test with very high sensitivity tests, or we test with, say, a lower sensitivity test, like an antigen test, that might pick up only 7 out of 10 cases. The most important factor they found, and others have found similar results, is that the frequency you give the test, every two days, three days, say, has the most important impact on how far and why the virus will spread. The best in their case was probably every three days.

08:44 SC: You also mentioned a proposal for how this might work on the federal level.

08:48 RS: A couple of weeks ago, the Rockefeller Foundation came out with a full plan to overhaul testing in the United States, and what they're calling for is 25 million antigen-like tests per week, and about 5 million diagnostic tests per week, so the PCR kind of test. We're already at pretty close to the 5 million mark right now. The real question is, can we ramp up the antigen testing, and there's some big hurdles to doing that.

09:14 SC: Is anybody able to make these rapid tests in the period of time that we need them?

09:18 RS: Very few of these tests actually exist now. There are some in the works, and there are a couple that are on the market, there are two companies that make them right now. One is called Quidel, another is called Becton Dickinson, but both those companies have designed a special
reader to make them more sensitive, and so while the test itself can be mass-produced, not
everybody has the readers, so then that becomes a limiting factor in how far they can be distributed.
So there are other folks who are proposing to design tests that would just be a paper strip test with a
simple readout that you could presumably make tens of millions of and distribute them far and
wide.

10:00 RS: The challenge here, though, is FDA rules come into play. There's a whole set of rules
that give the Food and Drug Administration authority over what is required to pass muster for
diagnostic tests, and sensitivity turns out to be one of those things. They approve tests that are
designed to give clinicians useful information, and so people can make decisions that will help their
health. They don't design tests for public health screening. The whole system is sort of not really set
up to do what the antigen tests excel at, so the question is, is can we very quickly overhaul this
system to allow less sensitive tests that would be more valuable from a public health standpoint than
an individual diagnostic standpoint.

10:46 SC: It does seem like there would be a lot of demand for these kind of tests if the companies
were allowed to produce them.

10:52 RS: Well, that's a great point. But think of this scenario, so if you are a company that has a
brand new antigen test that you want to make and sell, because boy, what school doesn't want to
reopen, what business doesn't want to reopen, sounds like you would have a market in the millions
or 100 millions, right? So you would think, oh, yeah, I'll just crank these out, I'll build this giant
factory, spend a billion dollars. We're also hearing a lot about vaccine makers having some initial
success towards lots of these coronavirus vaccines, so it's conceivable that six months from now
there's a vaccine for this whole thing that wipes this whole market off the board. So what some
people are advocating is, well, this is where the government can really step in and help take that
market risk out of it and say, okay, if you make this test, we will promise, just like we do with
vaccines, that we will buy 50 million or whatever the right number is. In that way, they have a
guaranteed market and a guaranteed return.

11:46 RS: Or another option is that the federal government has the power to use what's called the
Defense Production Act to take that technology and say this is required for the national defense of
the country, we're going to have it mass produced on our own, and we'll give you a fair cut. But that
takes federal leadership that we haven't seen yet. Maybe it will come, it's going to take some
political will to make those kinds of things happen.

12:11 SC: If we had rapid plentiful testing that was incredibly cheap, they could test you at the door
of the grocery store or at the door to school, would life be able to get more normal?

12:23 RS: That's the thinking behind this whole strategy, because pretty quickly within a matter of
weeks, as long as you get people to self-isolate, then you're going to be breaking trains of
transmission of the virus. The reason why we're having such a vexing problem with this virus is
people are passing it asymptomatically, they're passing it before they can get their test results back
from the PCR test, and so it just keeps going on and on. But if you can rapidly pull people out of
circulation that need to come out of circulation for a couple of weeks, well, then that breaks those
chains and it lowers community transmission of the virus, and over time you can get your arms
around it.

13:00 RS: And I'll just say one last thing about one other really big advantage of this approach is 'cause there's a lot of talk about contact tracing, and so the idea is if you have someone with a diagnostic test that gets a positive result, some group of people is supposed to call that person and all of their contacts and figure out who they've been in touch with and test all those people and maybe pull some of those folks out of circulation, but if you had everybody doing rapid antigen tests, you almost don't even need that approach anymore, because everybody becomes their own contact tracer.

13:28 SC: Thank you so much, Bob.

13:30 RS: Oh, you're welcome, my pleasure.

13:31 SC: Robert Service is a staff writer for Science. You can find a link to his story and all of our coronavirus coverage at sciencemag.org/podcasts. Stay tuned for an interview with Salma Mousa. We talk about if soccer can bring people closer together, even if they're on different teams.

13:54 SC: After violence recedes, how do the people left behind make peace? How do groups on opposite sides of a conflict live on and co-exist? These are not easy questions to answer. And studying how to build social cohesion after violent conflict has been tough. This week in Science, Salma Mousa writes about her work in Northern Iraq using soccer teams to investigate how social contact between Muslims and Christians might help build tolerance. Hi, Salma.

14:22 Salma Mousa: Hi, Sarah, thanks for having me.

14:24 SC: Oh, sure. Let's start with the area of the world that this study occurred in. I made some mention of violence and of peace, but can you paint a picture for what's going on in this part of the world?

14:37 SM: A lot of us in the summer of 2014 watched horrified as we saw ISIS take over large swaths of territory in Northern Iraq and Syria. Part of that occupation involved the ethnic cleansing of religious minorities in Northern Iraq, primarily Yazidis, but also smaller numbers of Christians and Muslim minorities. That kind of displacement experience and the trauma that comes with that devastated social cohesion and social trust in that area, and it especially impacted the relationship between Christians and Muslims.

15:10 SC: The target of your intervention is this idea of social cohesion. Can you give examples of how this isn't happening in this region, what kind of problems are ongoing?

15:20 SM: Social cohesion refers to patterns of cooperation between people who belong to different social groups, and that kind of cooperation is needed for very basic economic transactions and is thought to be critical for other kinds of development, like political and social development. What you see in Iraq and other parts of the Middle East is social cohesion is often conditional on what group we belong to, so we have strong in-group cohesion within a certain ethnic group or within a
certain religious group, but what you need are those bridging ties across groups, not just the bonding ties within groups, in order for those patterns of cooperation to be unlocked.

16:01 SM: The sectarian fault lines that we see in the Middle East, which were exacerbated by the American invasion and other geo-political dynamics in the region, are really making it difficult to bridge across social groups. You need some level of trusting people from other social groups in order to form coalitions when it comes to a political system in order to engage in business. Especially when you have a weak state or a state that is not always present, that trust becomes all the more important, and so that's really the thing that's missing from a lot of context in the world, but especially in post-conflict settings.

16:41 SC: For a lot of people, I think the big question here is why soccer, why use soccer as an intervention in something that's so serious?

16:50 SM: It is a very serious setting, and those kinds of fragile contexts require a mixture of policy tools to be combined with more grassroots interventions that aim to improve everyday interpersonal interactions. So you need the policy levels, you need things like power-sharing arrangements and protections for minorities, ceasefires and peace-building agreements, and at the same time at the grassroots level, you need some tools that are going to get people together and have them cooperate on an everyday basis.

17:23 SM: I focus on that set of tools that we have at the grassroots level. My work has led me to explore the contact theory, the idea that positive personal contact across group lines can improve intergroup relations and forge friendships and reduce prejudice. And so by focusing on the contact theory and thinking about how to improve these micro-foundations of social cohesion, there are a few conditions that are thought to be really key for contact to be optimal. It should be cooperative, it should place people from different social groups on the same level in terms of the power status. They should be cooperating for a common goal and the contact should be relatively socially acceptable, should be endorsed by communal leaders and relatively okay from a social norms perspective.

18:11 SM: And then thinking through all of these criteria, one setting really jumped to mind, and that's sports, especially soccer, team sports. So that you have this fundamentally equalizing effect that's very popular among different groups in the area, so it wouldn't be seen as taboo to engage in this kind of contact, and you are obviously cooperating for a common goal when you're playing on the same team. And because it was really a demand-driven project, we wanted to do something that resonated with the people in this area that they would want to engage in, and so for all those reasons sports ticked a lot of boxes.

18:45 SC: Yeah. In the intervention that you did, you actually changed who was on what team?

18:53 SM: Soccer, like other parts of life in Northern Iraq, is pretty heavily segregated. So we approached these pre-existing teams, which were already made up of Christians, and then we said that we're working with this local NGO, and we're going to set up a new set of soccer leagues, and we're inviting your team to play, but there's one condition on joining, we have this diversity
mandate, and we want to make sure lots of different groups are included. We're going to be mixing up the teams a little bit, so your core team will stay the same, but you're going to receive added players, and those added players may or may not be Christian. And so the randomization involved whether your team was going to receive three additional fellow Christian players or three Muslim players.

19:36 SC: What were some of the outcomes you looked at after these players were placed on the team?

19:42 SM: The outcomes that I collected can be categorized into three classes. The first is behaviors on the field, the second class of outcomes related to how people behaved toward members of the out-group, so towards Muslims in their everyday life outside of soccer. And the final class of outcomes pertain to intergroup attitudes.

20:06 SC: You saw the biggest change on the field. How were people who had this social contact behaving differently towards the end of the intervention?

20:13 SM: People who are assigned to mixed soccer teams were more likely to vote for a Muslim player not on their team to receive a sportsmanship award, they were more likely to register for a mixed team next season, and they were more likely to be training with Muslim players six months after the intervention ended.

20:31 SC: So that's positive changes in behavior on the field. What about off the field? So these people go home, do they suddenly hang out with families from a different religion?

20:42 SM: So when I moved to off-the field behaviors, the effects are much smaller, sometimes pretty close to zero. Playing on a mixed team did not make you detectably more likely to visit a restaurant in a Muslim neighborhood in Mosul, which was the ISIS capital. It did not make you more likely to attend a social event that was open to Muslims in the neighborhood, and it also did not make you more likely to donate your survey compensation to a neutral organization as opposed to the church.

21:15 SC: You also looked at attitude changes, so did people's beliefs about the out-group change after the social contact? Did you see any differences there?

21:25 SM: I found mixed results on attitudes. So I measured three attitudinal indices. One looked at what I call national unity, agreeing with statements like "life would be better off if we treat each other as Iraqis first instead of members of various ethnic or religious groups," and another item on the arbitrariness of group boundaries in Iraq. So when it comes to these abstract ideas about co-existence and treating each other as Iraqis first, there was a lot of movement. On the other two indices, one which reflected whether you blame Muslim civilians for Christian suffering, and another on whether you would want to have various Muslim groups as neighbors, I didn't see much movement.

22:06 SC: Do you think this suggests that behavior is easier to change than an attitude?
22:11 SM: I think that's one way to interpret it. It could be that in these fragile settings that behaviors are easier to soften between people who know each other, they might act a little bit softer toward each other and warm up to each other and even become friends. But when you ask them to zoom out and describe the entire out-group, especially after a violent conflict, those attitudes and those beliefs are deeply ingrained, at least in how people express them on a survey. One way that this paper hopefully pushes our thinking a little bit is also to unpack behaviors rather than just thinking about behaviors toward the people who we encountered in the intervention or in a specific program, to think about this differentiation between behaviors towards strangers and behaviors toward people we know, especially given that behaviors towards strangers is really the critical component for broader social cohesion.

23:01 SC: We should point out, though, that being on the winning team, or being on a team that had a lot of wins, actually made a difference.

23:08 SM: It did make a difference. It's hard to pin down the magnitude of these effects with precision, but there does seem to be this consistent pattern that the teams that made it to the knockout phases were those who saw more positive effects across a broader range of outcomes. And I take that as meaning that if you had a positive experience or a successful experience that that's going to unlock stronger effects. And it really points to the importance of the quality of the contact in these settings.

23:36 SC: I do wonder about the dynamics here on these teams. Christians are a minority in Iraq, they're under threat to some extent, but they're the majority on these teams. How does that play into what you saw here, how did you take that into account?

23:50 SM: This is a really important point. We have to contextualize these findings and this entire study in the broader scheme of Muslim-Christian relations in Iraq and in the Middle East. Christians are obviously a persecuted minority in many parts of their world. In the study sites, however, they were the majority group. So this is a little bit wacky for the dynamics of intergroup contact. We wanted to make sure that the Christian participants felt comfortable every step of the way, and not only that, but that we were using their feedback to help design the intervention and that the project staff was composed almost entirely of Christians from this region who were themselves displaced.

24:30 SM: By making sure that Christians were still the dominant group on each team, we mitigated some of the power differences that you see on a national scale, where Christians are this vulnerable minority, and then at the same time, our study sites had Christians as being the majority group. So taking that all into account, we hopefully created an environment where we had some equality between the participants, and that we also created an environment where we were not increasing intergroup anxiety or re-triggering any vulnerable communities.

25:00 SC: Why did you focus on the behaviors and attitudes of a Christian minority in Iraq as opposed to the Muslim majority?

25:07 SM: The more critical question for sustainable intergroup relations in the Middle East is how
Muslim majorities interact with and treat and view non-Muslim minorities. However, in this case, we had this unique opportunity to work with Christian communities in Northern Iraq. At the same time, we limited the study only to displaced communities, so the Muslims in the study were themselves displaced by ISIS, and actually half of the Muslims in the study are members of the Shabak minority, which was specifically targeted by ISIS. We anticipated that there would be positive effects of building social cohesion just among displaced people, and so in that sense, it motivated and it made sense for us to focus on Christians in this area, given that they are in the majority in the study sites.

**25:56 SC:** Given that you saw mostly changes in behavior and mostly that on the field, does this suggest to you that this type of intervention needs to be used very carefully in the future, that it might not work for the goals of broad social cohesion?

**26:13 SM:** So I do think that you need these two types of interventions to be working hand-in-hand. You need the policy tools at this high level, and you need the grassroots tools. This is one example of a grassroots tool. At the end of the day, this study is one data point, but it's a data point from a setting where we don't have that much evidence, especially causal evidence, on the effects of contact, and it's adding to this evidence base that suggests that contact after this kind of violence faces more challenges.

**26:42 SM:** And so what we need, and I'm sure a lot of people on this podcast say this, you need more studies like this, you need more replication, we need evidence from different samples, bigger samples from other parts of the world, especially post-conflict settings, so we can really start fleshing out this evidence base and start to understand how contact operates in the wake of this kind of violence.

**27:03 SC:** Alright, Salma, thank you so much.

**27:04 SM:** Thank you for having me.

**27:06 SC:** Salma Mousa is a post-doctoral fellow at Stanford University. You can find a link to her science paper at sciencemag.org/podcasts.

**27:14 SC:** And that concludes this edition of the Science Podcast. If you have any comments or suggestions for the show, write to us at sciencepodcast@aaas.org. You can listen to the show on the Science website at sciencemag.org/podcasts. On the site, you'll find links to the research and news discussed in the episode. And of course, you can subscribe anywhere you get your podcasts. The show was edited and produced by Sarah Crespi with production help from Podigy, Meagan Cantwell and Joel Goldberg. Jeffrey Cook composed the music. On behalf of Science Magazine and its publisher, AAAS, thanks for joining us.