Wildfire Smoke May Carry Deadly Fungi Long Distances

Pathogens in soil are a danger to firefighters, but smoke may transport spores that cause valley fever and other infections into cities too.

Since its inception in 1961, Kaiser Permanente’s Division of Research has become internationally respected for research that transforms health by discovering the key drivers of health and disease and identifying effective and efficient ways to deliver health care.

In 1961, the Division of Research is created.
Morris Collen, MD, becomes founding director of Medical Methods Research, later renamed the Division of Research, leading from 1961 to 1979.

1962 The Division of Research receives its first grant from the U.S. Public Health Service to automate the Preventive Health Examination.

2022 Annual Report
60 Years of Innovation
You may have heard the saying, “Time flies when you’re having fun.” In our case, time flies when you’re doing great research! It’s been 60 years since the Division of Research (DOR) was established. Kaiser Permanente physician and researcher Morris Collen, MD, took an idea — how to use computer technology to advance health care — and created the Department of Medical Methods Research, the precursor to today’s DOR.

In 2022, the Division celebrated those 60 years. We shared our vibrant history in an interactive timeline; told our story in a new video; and celebrated both virtually and in-person. We couldn’t be prouder of the thousands of staff members and researchers who — throughout the years — helped us get to this point.

Looking to the future, we continue to expand our work with postdoctoral research fellows — the next generation of researchers. In 2022, five new fellows joined the Division's postdoctoral training program, bringing our current number to 11. Many of our fellows transition to full-time staff positions at DOR after completing their training here, while others go on to research positions at other leading institutions. With the support of The Permanente Medical Group and the National Institutes of Health, we’ll continue to increase the vital opportunities we offer to fellows.

I’m also happy to highlight DOR’s investment in health equity research. Our Health Equity Research Supplements program supports studies on racial and ethnic disparities. In 2022 we had a second round of appointments to our Health Equity and Diversity Scholars Program, which provides career development support for early-stage investigators at DOR, with Oussey Zerbo, PhD, and Luis Rodriguez, PhD, receiving support from the program. Both the supplements and scholars program are supported by Kaiser Permanente Northern California Community Health.

There’s no telling what the next 60 years will look like for the Division of Research. I know we’ll continue to foster partnerships between clinicians and researchers, and explore new ways to advance health care for all. It’s likely our future work will involve care delivery ideas no one has even thought up yet! I’m privileged to take this journey alongside DOR’s imaginative, enthusiastic team, and I’m definitely enjoying the ride.

Tracy A. Lieu, MD, MPH
Director, Division of Research
Projects from across the Division of Research garnered newsworthy attention in 2022. Here are just some of the year’s top stories.
Online quiz to predict teen substance use

DOR researchers found there may be clues to a teenager’s drinking or drug problem in their medical history. They used that research and input from parents to develop a free online tool that anyone can use to predict the risk of a child’s substance use problem. “Clinicians’ ability to make predictions has been limited to anecdotal evidence and best-guesses, and research has shown those methods don’t work well,” said project leader Stacy Sterling, DrPH, MSW.

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Cannabis legalization may have made use easier in pregnancy

California’s legalization of cannabis for adult use may have reduced the stigma of using cannabis products during pregnancy and made them easier to obtain. The study, published in JAMA Network Open, reported insights from 18 virtual focus groups with Black and white pregnant patients who said they used cannabis during early pregnancy. “This focus group study is so important because it allowed us to hear directly from patients who use cannabis during pregnancy, providing rich, valuable, and actionable qualitative data,” said lead author Kelly Young-Wolff, PhD, MPH.

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Threshold for problem drinking identified

A study published in the journal Addiction examined the self-reported drinking habits of 138,765 adults to determine a threshold for a drinking problem. The analysis found 5 or more days of heavy drinking in a 3-month period predicts an increased likelihood that a person will develop a severe alcohol use disorder. “Thresholds can efficiently help primary care physicians identify patients most in need of further assessment, referral to specialty treatment, and treatment planning for alcohol problems and associated medical conditions,” said lead author Verena Metz, PhD.

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Helping patients with addiction tackle their health needs

An intervention that teaches patients in addiction treatment how to better connect with their primary care medical team resulted in long-term benefits over 5 years. The study was published in JAMA Network Open. “These patients have relatively high rates of early mortality and chronic illnesses, and tend to use emergency care rather than preventive services,” said lead author Esti Iturralde, PhD. “This intervention was designed to help them better connect with primary care, to give them the skills and confidence to advocate for themselves in the health care system.”

Read More

Researchers expand understanding of hernia genetics

A genetic analysis found 41 new locations on the human genome related to risk of hernia in the lower abdomen, known as inguinal hernia. The study, published in Human Molecular Genetics, also identified for the first time 2 locations associated with inguinal hernia risk in people with African ancestry and another 8 that show sex-specific effects. “Learning the specific genetic information related to causes of the disorder could lead to prevention and new treatments,” said lead author Hélène Choquet, PhD.

Read More
Higher street-level-traffic-related air pollution linked to increased emergency room costs

Long-term exposure to traffic-related air pollution is associated with higher health care costs for older adults. The study, published in Atmospheric Environment, was co-first authored by Stacey E. Alexeeff, PhD. “Originally, scientists thought pollution only increased risk for lung problems, but then we realized it also affected the heart, and new research suggests that it increases risk for diabetes and can reduce cognitive function,” said Alexeeff.

Impact of the Affordable Care Act on colorectal cancer incidence and mortality

The Affordable Care Act eliminated cost sharing for preventive services, including colorectal cancer screening for individuals aged 50-75 with private health insurance. A study on this population led by Catherine Lee, PhD, noted that “policies that remove barriers to screening, particularly financial burden from cost sharing, can result in improved colorectal cancer outcomes.” The study appeared in the American Journal of Preventive Medicine.

Immediate postpartum IUD insertion increases expulsion

Intrauterine device (IUD) expulsion increases the risk of unintended pregnancy. This study looked at how timing of postpartum IUD insertion and breastfeeding are associated with risk of expulsion and the relevance to the benefit-risk profile. The authors, led by Mary Anne Armstrong, MA, noted, “… IUD expulsion was rare but more common with immediate postpartum insertion.” The paper appeared in JAMA Network Open.

Kaiser Permanente study suggests many pregnant patients could avoid insulin injections

A study of patients treated for gestational diabetes with insulin or the medication glyburide did not find a difference in cesarean section rates or outcomes for the patients’ infants, suggesting many people with gestational diabetes could forego insulin injections in favor of taking a pill. The study, led by Monique Hedderson, PhD, published in JAMA Network Open. Study co-author Romain Neugebauer, PhD, led the application of sophisticated causal inference and machine learning analytic techniques that aim to emulate a randomized trial using real-life, observational data.

Smoking increases risk of bladder cancer recurrence

It’s well established that smoking cigarettes increases the risk of bladder cancer. Now, a study published in JAMA Network Open shows that current and former smokers are also at higher risk of having their bladder cancer recur after treatment. “Our finding not only supports previous smaller studies but expands our understanding of the role tobacco plays in bladder cancer,” said lead author Marilyn L. Kwan, PhD. The Kaiser Permanente Be-Well study is one of the largest cohorts of non-muscle invasive bladder cancer patients in the world.

Continued on page 7
Childhood weight tied to timing of puberty

Children who develop obesity at a young age are more likely than those with a normal, or healthy, weight to start puberty earlier. “We know that in adolescents early puberty is tied to an increased risk for depression and other mental health and behavioral problems, and that in adults it is a cancer risk factor,” said senior author Ai Kubo, PhD, MPH. The study, published in the American Journal of Epidemiology, is one of the largest on puberty and weight to include boys.

Gene tied to breast cancer treatment outcomes identified

A genetic analysis of the DNA of breast cancer patients enrolled in the Pathways Study has identified the first gene that predicts how a breast tumor will respond to certain types of systemic therapies. “The opportunity to examine genetic factors with detailed treatment information can result in new information that may have clinical implications,” said senior author Lawrence H. Kushi, ScD. The study was published in the journal npj Breast Cancer.

Association of physician adenoma detection rates with postcolonoscopy colorectal cancer

A study that included Kaiser Permanente patients in Northern and Southern California and Washington state found that a colonoscopy performed by a physician with a higher adenoma detection rate was significantly associated with a lower risk of postcolonoscopy colorectal cancer. “These findings may help inform recommended targets for colonoscopy quality measures,” wrote senior author Douglas Corley, MD, PhD, and colleagues. The study was published in JAMA.

Neighborhood greenspace tied to lower health care costs

Nature’s benefits may include savings on health care costs. A study published in Environment International showed the annual average health care cost was $374 lower per person per year for those living near the most green space than it was for those living near the least trees, shrubs, and grass. “Our study showed that across the whole range of neighborhoods there was a consistent pattern between living in areas with more green space and lower health care costs,” said lead author Stephen K. Van Den Eeden, PhD.

Breast cancer survivors are at increased risk for high blood pressure and diabetes

A study in the Journal of Clinical Oncology found breast cancer survivors are at greater risk of developing high blood pressure and diabetes than women who have not had breast cancer. “We suspected that cardiometabolic health problems might be common among breast cancer survivors,” said lead author Marilyn L. Kwan, PhD. This is significant, said co-author Jamal S. Rana, MD, PhD, because “diabetes and hypertension are 2 of the biggest risk factors for heart disease.”

Colorectal cancer screening program reduces disparities in outcomes

Kaiser Permanente Northern California eliminated colorectal cancer disparities between Black and white adult members after it instituted a regionwide, structured colorectal cancer screening program. “I knew our program had helped to reduce disparities, but I was surprised by the magnitude and the rate of improvement. It exceeded my expectations,” said senior author Theodore R. Levin, MD. The study published in the New England Journal of Medicine.
Largest-ever study of thoracic aortic aneurysm supports treatment guidelines
Patients who have a thoracic aortic aneurysm are at risk of certain complications. A unique population-based study in *JAMA Cardiology* provides high-quality evidence that in the U.S. most patients are not likely to have an aortic dissection and may not need open-heart surgery. “This research was critical because of the paucity of evidence to guide clinicians and the ongoing debate as to how large an aneurysm should be before recommending a very high-risk surgery,” said lead author Matthew Solomon, MD, PhD.

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Low stroke risk in patients with very narrowed neck arteries causing no symptoms
Most patients with asymptomatic carotid stenosis could potentially be treated with the newest medications and may not require surgery. “The question of how to best treat patients with narrowing of a carotid artery without symptoms has been a long-standing research priority,” said first author Robert Chang, MD. The study, published in *JAMA*, is believed to be the largest and most current retrospective assessment of long-term stroke risk in this population.

Read More

Heart disease and stroke deaths up during COVID-19 pandemic
An analysis of data collected by the CDC published in *JAMA Network Open* found deaths from heart disease and stroke due to factors other than an aging population increased during the first year of the pandemic in the U.S. “We had been making progress in reducing deaths from heart disease and stroke due to preventive measures and timely interventions,” said lead author Stephen Sidney, MD, MPH. “Our study showed the pandemic didn’t just stop these gains, it reversed them, with Black, Latino, and Asian American adults hit hardest.”

Read More

Mammography can offer clues to a woman’s heart health
Screening mammography is used to look for early indicators of breast cancer. A study in *Circulation: Cardiovascular Imaging* shows mammograms may also help clarify a woman’s risk of having a future heart attack or stroke or developing other types of cardiovascular disease. “Our findings add to the body of evidence that suggests breast arterial calcification seen on a mammogram of a postmenopausal woman provides additional information that can be used to assess her heart health,” said the study’s first author Carlos Iribarren, MD, MPH, PhD.

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Blood pressure patterns in early pregnancy tied to later risk of pregnancy-related hypertension complications
Physicians may be able to use blood pressure patterns to identify pregnant women most likely to later develop high blood pressure-related complications. “Our study shows that a woman with normal blood pressure that increases or shows little or no decline during the first half of pregnancy is at substantially higher risk of developing a hypertensive disorder in the second half of pregnancy,” said the study’s lead author Erica P. Gunderson, PhD, MS, MPH. The study was published in *Hypertension*.

Read More

Benefit of dialysis unclear for older people with chronic kidney disease and heart failure
Kidney replacement therapy with chronic dialysis only slightly extends survival in people with advanced chronic kidney disease and heart failure. “In older adults with heart failure, advanced chronic kidney disease substantially increases mortality and the best treatment strategy to maximize outcomes remains unclear,” said senior author Alan S. Go, MD. This finding, published in *PLOS One*, can help physicians and patients decide whether to initiate dialysis or choose more conservative management.

Read More
Home-delivered medically tailored meals may benefit recently hospitalized patients with heart failure

Healthy eating patterns are key to reducing risk for common health problems. Providing nutritionally tailored meals — “food is medicine” — for targeted chronic problems is a popular approach. A randomized trial suggests tailored meals may benefit recently hospitalized patients with heart failure compared with usual care. “People with certain chronic disease often are given guidelines for eating healthy meals, but they may not be financially or physically able to obtain them,” said Alan S. Go, MD. The study was published in Medical Care. ▶ Read More

Lifestyle coaching helps Black adults control high blood pressure

Culturally tailored lifestyle coaching can help Black adults with hypertension improve blood pressure control. That’s key to reducing risk for stroke and other hypertension-related problems. “Black adults have the highest rates of high blood pressure and, for reasons we don’t fully understand, it starts at a younger age and results in strokes, heart attacks, heart failure, chronic kidney disease, and other serious hypertension-related health problems occurring at an earlier age as well,” said senior author Stephen Sidney, MD, MPH. The study published in JAMA Network Open. ▶ Read More

Messages from doctors increased COVID-19 vaccination among Black, Latino elders

A clinical trial compared methods to reach at-risk populations and found elderly Black and Latino people more likely to get a COVID-19 vaccination after receiving an email or letter from their doctor. “This study’s randomized controlled trial design makes these findings particularly compelling. We were able to directly compare the effectiveness of different forms of outreach,” said lead author Tracy Lieu, MD, MPH. The report on the randomized clinical trial was published in JAMA Network Open. ▶ Read More

Intervening with at-risk adolescents shows long-term benefits

A long-term study following adolescents who reported substance use or mood problems at a pediatric clinic found those who had access to a brief intervention and referral to treatment were less likely to have a diagnosed substance use disorder or related inpatient hospitalization as young adults. “For the first time we’ve been able to look at outcomes among young adults, well after an intervention was delivered in pediatric primary care,” said lead study author Stacy Sterling, DrPH, MSW. The findings appeared in the Journal of Adolescent Health. ▶ Read More
National quality measurements may not accurately reflect a hospital’s surgical risks

Health care quality measurements are used to assess and improve patient care. But the data used by a national group to measure an individual hospital’s quality may lead to inaccurate results. “We found the complication rate in our hospitals were similar from one hospital to the next, suggesting that care had been standardized, which was reassuring to our surgeons,” said senior author Lisa Herrinton, PhD. Published in Population Health Management, the study, will inform efforts to measure surgical quality.

Read More

Exposure to small children linked to lower risk of severe COVID-19

Adults with young children were less likely to have severe illness from COVID-19 than similar adults without children. The research in the journal PNAS suggests prior exposure to a coronavirus could offer cross-reactive immunity and provide resistance to severe illness from COVID-19. “One possible explanation is that constant exposure to colds helps people develop some immunity to these viruses,” said lead author Matthew Solomon, MD, PhD. These results can inform risk patterns for the ongoing pandemic.

Read More

Not all heart failure patients require hospitalization

A new risk calculator could help emergency department physicians determine which patients with acute heart failure should be hospitalized and which can safely be discharged. “Historically, there have been very high admission rates for patients with acute heart failure from the emergency department,” said lead author Dana R. Sax, MD, MPH. This and similar innovations testing risk stratification using cutting-edge data approaches offer the potential to revolutionize improvements in both patient outcomes and care value. The study was published in JACEP Open.

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Some pulmonary embolism patients effectively treated in primary care

Some people who get blood clots may not need to go to the emergency department. A study in the Journal of General Internal Medicine by the CREST Network assessed how some patients diagnosed with acute pulmonary embolism fared. The results suggest some pulmonary emboli may be handled by primary care clinicians safely, said lead author David Vinson, MD. Researchers continue to question and test established paradigms to evaluate and implement new pathways for improving patient outcomes.

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New, innovative support for people with serious mental illness

People with severe and persistent mental illness often rely on medication to stave off symptoms. But side effects can make these drug regimens challenging. “Schizophrenia and bipolar disorder often develop earlier in life, and these younger patients can struggle with the idea of going on lifelong medication,” said Esti Iturralde, PhD. A paper in NEJM Catalyst described an innovative telehealth program that adds psychiatric clinical pharmacists to care teams to deliver comprehensive care to this vulnerable population.

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New radiology reporting system decreased time to pancreatic cancer diagnoses

Using standardized terms and hashtags creates a clearer path for earlier detection of pancreatic cancer. “If the radiologist’s description is not easily understood by the physician who ordered the scan, it may take longer for suspicious findings to be acted upon,” said senior author Lisa Herrinton, PhD. Published in Clinical Gastroenterology and Hepatology, the study uses expert consensus and next-step embedded patient navigation guidance to ensure simpler, consistent, delivery of care.

Read More
Blood clots in hospitalized patients tied to worse outcomes

The incidence of blood clots in hospitalized and recently discharged patients has slowly increased over time. The reason for this increase is currently not known. Co-author Vincent Liu, MD, MS, is developing a tool that can scan an electronic health record at the time of a hospital admission and calculate a patient’s blood clot risk. “Our goal is to help physicians and patients by introducing the tools into our hospitals in the near future.” The study was published in JAMA Network Open.

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Not all adults newly diagnosed with diabetes equally likely to start treatment

For adults newly diagnosed with diabetes, getting blood sugar levels under control is the first goal — with medication if needed. Yet adults of certain racial and ethnic groups are less likely to start medication within the first year of diagnosis, found a study published in the Journal of General Internal Medicine. “If we don’t understand what is driving the treatment differences we are seeing, we don’t know if the decisions are clinically appropriate,” said co-lead author Anjali Gopalan, MD, MS.

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Racial and ethnic disparities in COVID-19 infections are not explained by social risk factors

Holding a public-facing “essential” job and living in a multigenerational household may be key contributors to the higher COVID-19 infection rates seen early in the pandemic in Black, Latinx, and Asian adults in the U.S. “We expected that pre-existing health problems and social risk factors would explain the differences in our population’s COVID-19 infection rates. But they didn’t,” said senior author Richard Grant, MD, MPH. The study was published in the Journal of General Internal Medicine.

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Early antibiotics for sepsis supported in new study

A large multi-hospital analysis found that early antibiotics in sepsis patients resulted in improved health outcomes for them without expanding overall antibiotic use or worsening antibiotic resistance in others. The findings are good news for hospital physicians who want to act fast to respond to sepsis — the body’s overreaction to an infection — which can turn deadly within hours, said senior author Vincent Liu, MD, MS. The study appeared in JAMA Internal Medicine.

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Medical assistants help close virtual visit digital divide

Patients participating in video visits with primary care doctors benefited from having a medical assistant help connect the call. The research draws attention to the important role of medical assistants in Kaiser Permanente’s virtual and in-person care, the authors said. “The involvement of a medical assistant seemed to reduce the technology gap,” noted senior author Mary Reed, DrPH. The study published in JAMA Internal Medicine.

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COVID-19 patients did better if they had booster vaccination

A large analysis of COVID-19 patients in Northern California found higher rates of hospitalization and advanced medical care for COVID-19 patients who were unvaccinated, were vaccinated but not boosted, or who had an additional health condition such as obesity or heart disease. The study was published in The Lancet Regional Health – Americas. “COVID-19 vaccines and boosters remain the most important tool that we have to prevent severe illness with COVID-19,” said lead author Jacek Skarbinski, MD.

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Study offers reassurance to pregnant patients using biologic medications for autoimmune disorders

A study published in Pediatrics found no higher rate of adverse health events in babies of mothers who took biologic response modifier drugs (BRMs) during pregnancy and who received the live attenuated measles or rotavirus vaccine. There was concern their infants could have immune suppression. “These data may provide some reassurance to parents and also to pediatricians who ask themselves what they should do when they come into contact with children who were exposed to BRMs,” said lead author Ousseny Zerbo, PhD.

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Lower in-hospital mortality for vaccinated patients hospitalized with COVID-19

COVID-19 patients in Kaiser Permanente Northern California hospitals during the delta surge of 2021 were less likely to die in the hospital of COVID-19 if they were vaccinated. The study was published in the Journal of Internal Medicine. “These findings suggest that COVID-19 vaccines were protective against in-hospital mortality during the delta wave,” said lead author Laura Myers, MD, PhD. “This is particularly important for patients whose other health conditions may put them at greater risk,” said co-author Nicola Klein, MD, PhD.

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Early data on COVID-19 vaccine in teens shows booster effectiveness

An analysis of early data on the effectiveness of the Pfizer/BioNTech COVID-19 vaccine in children and teens found that a third shot, or booster, extended protection against emergency department and urgent care visits in 16- and 17-year-olds. The study was published in the CDC’s Morbidity and Mortality Weekly Report. “These results, while early, suggest a real benefit for a third, booster vaccination in teens that may extend protection against disease severe enough to seek immediate care,” said lead author Nicola Klein, MD, PhD.

Read More

Small increase in myocarditis/pericarditis in some recipients of mRNA COVID-19 vaccines

DOR researchers leading Vaccine Safety Datalink surveillance of mRNA COVID-19 vaccines reported in Annals of Internal Medicine slightly elevated incidence of myocarditis/pericarditis among certain patients the week after vaccination. Incidence was highest for male adolescents and teens after their second dose and first booster. Authors Kristin Goddard, MPH, and Nicola Klein, MD, PhD, said the study affirms the importance of ongoing surveillance for health effects and emphasized that current evidence supports the COVID-19 vaccine’s continued use.

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Focusing on specific risk factors for heart failure in people with HIV

DOR researchers delved into health records to better understand the factors that increase heart failure among people with HIV. Using a large matched sample of people with and without HIV, they found greater risk of heart failure in those with more severe HIV, particularly in women. The results, said authors Jennifer Lam, PhD, MPH, and Michael Silverberg, PhD, MPH, emphasize the need to optimize HIV treatment and management to maximize heart failure prevention, particularly among women with HIV.

Read More
Early control of blood sugar key for gestational diabetes

Pregnant patients treated for gestational diabetes had better birth outcomes if they rapidly improved their blood sugar levels soon after diagnosis rather than having slow or no improvement, according to research in JAMA Network Open. “Glycemic control is a cornerstone of gestational diabetes management, so it’s important to learn in detail about the trajectory of control between diagnosis and delivery,” said senior author Yeyi Zhu, PhD.

The study found patients who did better were more engaged with nurse support, said lead author Rana Chehab, PhD, MPH, RD.

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New clues in early prediction of gestational diabetes

DOR researchers identified several biological markers in the blood of pregnant people that they tied to an increased risk of developing gestational diabetes later in pregnancy. Their study was published in Diabetes. “These findings could lead to the development of new laboratory tests for the disease, and help understanding of the biological mechanisms that lead to a gestational diabetes diagnosis,” said lead author Yeyi Zhu, PhD.

Read More

Pandemic stressors and pregnant patients’ mental health

Pregnant patients reported more severe mental health symptoms when they faced childcare challenges and food insecurity and were distressed about changes in prenatal care. The study, led by Lyndsay Avalos, PhD, MPH, was published in the International Journal of Public Health. A related study in Frontiers of Psychiatry found Black pregnant patients more likely to report depression and anxiety. And a study led by Sylvia Badon, PhD, in the Journal of Affective Disorders found physical activity and connecting with others were pandemic coping strategies associated with better mental health during pregnancy.

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Autistic people join autism project — as research partners

Members of DOR’s Autism Research Program trained autistic people in the research process and how they can be part of it. Autistic people could be involved at every stage of research, from the generation of the idea to execution of the project, said program leader Lisa Croen, PhD. Participants also joined a focus group to discuss gender, sexuality, and reproductive health of autistic people, a topic being studied by the research program. “The whole idea of community-based participatory research is growing, particularly in autism research,” said Jennifer Ames, PhD.

Read More

Coronavirus may double severe complications in pregnancy

An analysis in JAMA Internal Medicine showed people who had a coronavirus infection during pregnancy had more than double the risk of negative outcomes compared with individuals without the virus. “These findings add to the growing evidence that having COVID-19 during pregnancy raises risks of serious complications,” explained lead author Assiamira Ferrara, MD, PhD.

The study team will follow the mothers and children to study potential short- and long-term effects of COVID-19 infection in pregnancy, said co-author Monique Hedderson, PhD.

Read More
The Division of Research (DOR) is currently home to 66 research scientists and staff scientists, 11 research fellows, and nearly 640 employees. The DOR also has 47 adjunct investigators from within Kaiser Permanente and other academic institutions. DOR’s scientists are involved in 585 ongoing research projects and its Clinical Trials Program supports and guides 345 clinical trials. Since 2000, DOR researchers have published more than 6,500 peer-reviewed articles, including 575 papers in 2022 alone.

**2022 TOTAL REVENUE: $133 MILLION**

![Pie chart showing revenue sources]

*Incl. CESR, Garfield, KP Biobank, etc.*
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