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**Announcer:** *The BioWorld Insider* podcast.

**Lynn Yoffee:** This is the *BioWorld Insider* podcast. I'm Lynn Yoffee, *BioWorld*'s publisher. In the global fight against COVID 19, you might have heard about a small startup that's poised to unleash a multi-billion dollar COVID 19 blockbuster drug, along with New Jersey-based Merck and Company. Merck and its partner, Ridgeback Biotherapeutics a company BioWorld first introduced in 2019, are pursuing emergency use authorization for the drug called Molnupiravir. A Phase 3 trial showed the oral antiviral cut the risk of hospitalization or death from COVID by half.

Now with global governments already pledging to buy big lots of the pill, pending regulatory approvals, of course, it's on the precipice of becoming the first drug of its kind to treat COVID. A pill, that's a real game-changer. With the meeting of the FDA's advisory committee scheduled to consider the evidence for Molnupiravir on November 30th, we're continuing to follow the story, but there's a surprising story behind the story. It's a little complicated and quite controversial. It touches on the US government's role in funding, the life-saving research that led to the development of this new drug.

It's about the growing concern that Merck is planning to charge more than $700 per treatment when taxpayers have already bankrolled a reported $29 million to support the research. A recent analysis by researchers at Harvard and Kings College pegged the real cost to make the treatment at around $18. Today, we're glad to welcome Joseph Allen, he's the Executive Director of the Bayh–Dole Coalition, and will help us untangle that scenario and tell us how technology transfer aided in the development of Molnupiravir.

BioWorld managing editor, Michael Fitzhugh, will guide the discussion so that we can better understand the brewing controversies with an emphasis on the drugs, ultimate price. Over to you, Michael.

**Michael Fitzhugh:** Thanks, Lynn. For those of you who don't know much about the Bayh–Dole Act, I have to admit, that was me for a long time. It basically helps the private sector to commercialize and profit from federally funded research. I think Joe is going to tell us that it also plays a big role in making the United States the world's leading innovator, but we'll get there in a minute. First, Joe, thanks for joining us.

**Joseph Allen:** Thank you for having me.

**Michael Fitzhugh:** There's a lot to talk about with a potential new COVID 19 treatment in Molnupiravir on deck and what the Bayh–Dole Act has to do with it, but to set the table a little bit first, could you tell us a little bit more about what the Bayh–Dole Act is and how it fits into your story?

**Joseph Allen:** Sure, I'm happy to. Basically, after World War II, the US government had a policy that anything the government funded, any invention would be basically made publicly available through non-exclusive licensing, which was like a Marshall plan of technology development after World War II. Until the '50s, until the '60s really, we didn't have much international competition. Europe and Asia were pretty devastated by the war. What became apparent was that there was no incentives for anyone to actually take government-funded research and make it into any usable product.

The reason is very simple because the US government is funding fundamental research, and that's really a long way from a product, it's more like an idea than a product. What we found was, when I was on the Senate Judiciary Committee for **[unintelligible 00:03:42]** was that the government was funding about half of the research in the country, but virtually nothing was being commercialized. We also had Japan and Germany at that time, taking markets away from the US. We had double-digit inflation, double-digit unemployment. We thought, "This doesn't make any sense."

Even worse than that, we found that not a single new drug had been developed from the National Institute of Health funding when the invention was taken away from universities. What Bayh–Dole does is it changes that, and it says the government funds the research and a university or a small company that makes an invention with federal and can own it. They have to give a preference and licensing to a small company that will make the invention in the United States. We basically said I would quibble a little bit with your introduction.

The Bayh–Dole Act is not to help companies profit, the Bayh–Dole Act is to help the consumers, both here and around the world, actually get a tangible benefit out of government research. I guess the question is, do you want a research paper or do you want a new drug or a honey crisps Apple, or Google? All those came out of Bayh–Dole. Fast forward, 40 years later, we now have about 300 new drugs and vaccines on the market because of Bayh–Dole. The US is the leader in Biotechnology and life sciences, we were not that before Bayh–Dole.

Bayh–Dole is one of the drivers of the US economy. It contributed an estimated $1.7 trillion with 't' between 1997 and 2017 and supports about 6 million new jobs. The US creates three new companies every day of the year on average because of academic inventions. We also commercialize about two and a half new products every day. Bayh–Dole has been a significant driver of the US economy and had a huge benefit on public health and welfare, not just in the US but around the world.

**Michael Fitzhugh:** I've got to admit that in the introduction there, I definitely might have been baiting you a little bit. I can understand your quibble.

**Joseph Allen:** No, listen, I'm not offended, I just want to make that point.

**Michael Fitzhugh:** It sounds like in terms of the benefits the Act was intended to deliver, those incentives, those translations of academic and other government-funded research into products, those intended benefits have really been delivered on in a number of industries, not least of which being life sciences. Maybe it'd be a good time to move on to Molnupiravir then. We're talking about an oral antiviral drug invented at Emory University with support from US government funding and later licensed from Emory to Ridgeback Bio for further development.

Ridgeback and Merck formed a partnership not long after, and they've been advancing the drug together ever since, most recently, applying, like Lynn said, for FDA emergency use authorization for the treatment of mild to moderate COVID-19. What role is Bayh-Dole playing in that story?

**Joseph Allen:** Well, basically, as you mentioned, Emory University made the invention with government funding, so it falls under Bayh-Dole. Under Bayh-Dole-- Before Bayh-Dole, it would've been taken to Washington and it probably would've just sat on the shelf because there was no incentive to develop it. Under Bayh-Dole, Emory University owned the invention, they thought it was significant. One of the geniuses of Bayh-Dole was we let the people creating the technology really manage it because, a lot of times, it's really hard for somebody outside the system to really understand that.

Basically, Emory thought they really had something significant. They were actually working on it before COVID, but when COVID came out, they said, "Hey, this really could be a big breakthrough." Remember, this is hard to imagine now, but 18 months ago, there were no therapies. We didn't have anything to fight the COVID. A lot of people seem to have forgotten that already. Emory basically started looking for a partner. Under Bayh-Dole, we said that you have to give a preference for a small company. Ridgeback Biotherapeutics came in. They'd actually done some work on an Ebola vaccine.

Under Bayh-Dole, you don't just have to be a small company, you have to have a feasible commercialization plan. You have to come in and really show that you have an idea of how to commercialize this. Emory was very impressed with Ridgeback and it gave it the license. Ridgeback was really looking to--- Again, remember 18 months ago, we had a crisis because the hospitals were getting overrun. We had people getting COVID, people dying from COVID here and around the world, and there was really nothing they could do. Ridgeback went to-- There's a thing called the Biomedical Research and Development Agency at NIH.

That was established because a lot of things are high risk and high priorities and they want to make sure they're accelerating the development. This is outside of Bayh-Dole. Ridgeback went to BARDA and said, "Hey, listen, we've got something significant here. We'd like to get your help on developing it. We really want to move this as quick as possible." BARDA turned them down because the person running it thought, "Well these people, we've seen this drug before. It might have some side effects. I don't like being pressured. These guys are being too high pressure." I actually did a webinar last year on Bayh-Dole and the COVID crisis.

I asked some of the people at the National Institutes of Health, I said, "I'd like to get a small businessperson that could really talk about what's being done to fight COVID." They recommended Wendy Holman, who is the CEO of Ridgeback. Wendy came on and she was telling, she obviously had a huge sense of urgency, but she also said how frustrating she was trying to work with the government. She said in her words, "We're working 24/7 during the pandemic trying to do something with this potential breakthrough, and we can't get anybody to respond."

What they did was, they gave up on government funding and found Merck. Ridgeback on their own had actually funded some of the initial trials, which actually showed there was a good efficacy. Merck picked it up and started moving, and then BARDA came back later and partnered with them, and actually have moved it to market. It's not just a Bayh-Dole success story, it's also an example of why entrepreneurs drive our system in the US as opposed to the government bureaucracy. Although the government helped, but without Wendy Holman and Ridgeback, this would still be sitting somewhere.

Here we are 18 months later, and it looks like we might have something that can reduce hospitalizations by 50%. Think about what the value of that is, not just to the health, but to international economies. To me, it's a miracle. I'll say that quite bluntly. I love Wendy, I love what she did, but it's an example of how the system works. To think we'd be here thinking that they pulled something off untoward when actually it looks like they might have really done something to help save the world, I just can't join it.

I feel very grateful that our people develop the best vaccines in the world in record time, under Bayh-Dole partnerships, and now we may have a pill that does it, but the development and the commercialization is the Bayh-Dole thing. Pricing falls outside of Bayh-Dole, so they're really two separate issues. Again, if 18 months ago, somebody said you could take a pill, it would reduce hospitalizations by 50%, what would you have said that was worth?

**Michael Fitzhugh:** Obviously, there's a huge success story to be seen there, not just for entrepreneurship, but tech transfer, and obviously for patients if this gets emergency use authorization, and perhaps a full approval later on. In terms of, I think, you alluded to the controversy around this, and a lot of that revolves around pricing. As you noted, that may be outside Bayh-Dole.

As people have recognized this progress, there have also been objections to the idea that the government has funded this to a large degree in early development, that there are tax dollars that are being spent to, not only contribute to development but also to support the manufacturing. What are people owed in circumstances like that where tax dollars have paid for our government invention, and at the end of the day, are people at a discount, is the innovation itself enough?

**Joseph Allen:** Well, that's a great question. I'm just talking about US policies now, they may have different things than other countries. Now, this is outside of Bayh-Dole, but what happened was after we passed Bayh-Dole, particularly in medicine, it became apparent that some of these things are so high risk that companies simply won't do it on their own. In fact, if you go to our National Institutes of Health, they have a hard time licensing any vaccine to find anybody who's interested.

When we had the Zika vaccine, they couldn't find a single licensee, and when they did, they were publicly attacked for the same thing these people are being attacked for right now. Basically, I think where we've made the decision in the US is we want to err on the side of getting these things out to the market as quickly as possible. They're made available in the US first, our government now, the Trump administration and the Biden administration has said, "Hey, we're going to go ahead and actually order this, assuming it's going to be approved by the Food and Drug Administration."

The government has a lot of say over the price. In fact, the Biden administration has just contracted with Merck for I think, 200 doses of the new pill. Again, we had the same debate on the COVID vaccine, and we've heard these people are going to gouge the public, "Oh, this is horrible. Look at what these terrible people are doing." I don't know if you've gotten the vaccine yet, but I didn't pay anything for it. Again, the reason was he had these government-private partnerships. We'll see what happens with Merck, but Merck has already negotiated with some of the generic drug companies to make it available.

They are manufacturing around the world. Certainly, it needs to be affordable. In fact, companies want to sell products, but when the price is so high, nobody can do it. It's one thing to make the criticism, but all of our government programs, like BARDA, they support this, don't have a price provision in there, and there's a simple reason for that. The critics now who are attacking Merck and attacking Ridgeback, attack the vaccine makers.

About 20 years ago, they browbeat the National Institutes of Health into putting a reasonable pricing provision into their licenses and their cooperative agreements with the industry for the same reasons we're hearing right now. Now they couldn't define what a reasonable price was because nobody can do that in advance. Just like this pill, we're talking what the government put in, what did Ridgeback, and what did Merck put into it? They had some real costs there. Again, if you're selling a drug or a vaccine, you don't only have to recover the cost you put in this product, but 95% of your projects for new drugs fail.

Somebody has to pay for that, and the consumer and the government doesn't pay for that. There's a lot of things that go in there. What happened was NIH put this reasonable pricing provision in their agreements in the 1990s. What was the result? Was it at a golden age of cheap drugs? No, what happened was companies walked away. "You've made the risk so high, we won't partner with you now," and that happened for five years. Finally, Harold Varmus, the Director of NIH after, five years said, "This had achieved no public purpose, all it's done is killed partnerships."

He removed that pricing provision and agreements went back in place, which is exactly why, 18 months ago, companies would partner with the government because he understood what the rules were. Again, I have no say, I have new expertise on what's going to happen with the pill, but we had the same debate for the vaccines, and they are made available to the public for free. Will this be free? I don't know, but we've made a choice now and the government that we want to make sure these things are available. Then we'll work with the market to try to make them affordable.

Everyone who's looked at this issue, and it's being debated right now in our Congress. The Democrats are trying to have the drug companies negotiate with Medicare. They're split, even among the Democrats,

how do you do price controls? Because the line is so thin between getting things developed and making them basically have companies walk away, that every time you try to impose artificial prices, things just wind up not being developed, which to me is the worst of all worse.

What would happen if this pill was sitting on the shelf? That could easily have happened, but for Ridgeback, this would be sitting on the shelf at Emory, and it may never have been developed. I think I made one mistake of the US government has actually funded 1.7 million courses of the pill. Again, it's good that we're doing that because it assures the company they're going to make some sales. We did the same thing with the vaccine development. Again, the government's got a big role in setting what the price is going to be because, obviously, they'll negotiate with the company for what price they're buying it for.

Again, we all want to make sure I don't get any discount because I worked on Bayh-Dole when I buy my prescriptions. The most important thing is to make sure we get these things developed as quickly as possible. As flawed as it may be, the US system runs rings around the rest of the world. We can say it should be better, we say we could change it, but everyone that's looked at this that I've seen has not come up with a better solution than frankly what we're doing right now.

**Michael Fitzhugh:** You talked a little bit about the effort at the NIH to specify a reasonable price, or I think reasonable terms for medicines that were developed from there, from intellectual property that they supported. You can correct me if I misphrased that. I understand that some people in Washington are talking about part of Bayh-Dole that gives the government rights to march in on patents. Can you tell us a little bit about what march is and the context or the way in which it's being talked about in Washington right now?

**Joseph Allen:** Sure, I'm happy too. Basically, even before Bayh-Dole, as I mentioned, the government would take invention rights away from the developer or the inventor, but it soon became apparent that policy was not working very well. President Kennedy and President Nixon said we'll have waivers where the inventor, inventing organization can petition the government to own the invention that they made with federal funding. If that was done in the exceptional cases, the government always had a march-in the provision, which wanted to make sure that, in fact, you're making good faith efforts to commercialize the technology.

March-ins preceded Bayh-Dole, and they've always been used because, again, the purpose of Bayh-Dole was to make sure we're getting these things to the market as quickly as possible. They adopted march-in rights and they say, basically, if a university had licensed an invention made with federal support, and good faith efforts are not being made to commercialize it, the government can march in and force them to license another party. The government can also march in if it looks like the developer is not able to meet the needs of a national emergency.

That's the way the law worked for 20 years. Twenty years after Bayh-Dole, the same people who tried to kill it wrote a law review article and said that they'd found hidden meaning in Bayh-Dole. While I was on the staff of Senator Bayh, and basically, I laughed when I read that because what they did is they quoted the critics of Bayh-Dole and anti-Bayh-Dole hearings. I didn't take that seriously, but then they started publishing in the *Washington Post* that Bayh-Dole will allow the government to come in and set prices. Senator Bayh pushed back on that, he said that's not how the law works.

Nevertheless, they filed a series of petitions. Under Bayh-Dole, anyone can write a petition to the government to march in under the statutory criteria. There have been a series of petitions filed under Democratic and Republican administrations asking the government to march in to set prices for things that were successfully commercialized. Every one of them has been dismissed. In fact, most were dismissed under the Obama-Biden administration because they've said that's not how the law works. Nevertheless, that still persists. People are still pushing the same theory.

Senator Bayh said, "Listen, anyone is free to second guess us and say that we should have had price controls in there. If you want to do that, the way of doing it is you have to amend the law. If you amend the law, you better state, in statute, what you mean by a reasonable price because that's completely arbitrary." No one has actually done that because I think people realized it would actually kill the bill. It's a political thing that keeps coming up, it's never been successful. In fact, the *Washington Post*'s fact-checker just checked it a couple of weeks ago and dismissed it as a theory that has had no support and has a dismal track record.

Politically, I think it resonates, it seems like something where it always gets people fired up if they think that they're being cheated. Bayh-Dole is about commercialization. Remember, before Bayh-Dole, not a single drug had been commercialized, which is the ultimate waste. Under Bayh-Dole now, we've not only got 300 drugs and vaccines on the market from federally-funded research, but the US is the leader in Life Sciences, as well as other fields of technology. I would argue that's a huge benefit, which should not be taken lightly. The last thing we want to do is kill our innovation system by adding on arbitrary things like price control.

Remember, under Bayh-Dole, this would happen as you sign the license, before you'd actually commercialized anything. Our system is driven by small companies like Ridgeback, 50% of the new drugs in the United States come from small companies. They have to get venture funding. No venture capitalists would ever fund a company with that hanging over them because what it means is if you're stupid enough to commercialize a technology, anybody could file a petition saying they don't like your price, and the government would then licensure rivals.

That's why when NIH tried this, the system collapsed. It didn't reduce prices, it's simply collapsed the system.

**Michael Fitzhugh:** It sounds like you are seeing Bayh-Dole as quite robust in its current form, and not particularly vulnerable to re-interpretation going into the feature of the Biden administration or beyond?

**Joseph Allen:** Oh, it's vulnerable. In fact, right now, Dr. Francis Collins, who has actually been a big supporter of Bayh-Dole, who's turned down the petitions, well, he's resigning from NIH. They're already starting-- The critics who go back 40 years, this fight goes on when Bayh-Dole was started. The critics are urging the Biden administration to appoint somebody who will violate Bayh-Dole and try to misuse it for march-in rights. It's certainly vulnerable, but I think one encouraging thing is Senator Joe Biden when he was a Senator, actually supported by Bayh-Dole. He was on the judiciary committee with Bayh and Dole and voted for the bill.

Hopefully, saner minds will prevail, but again, the danger is if you misuse Bayh-Dole, you're not going to lower prices. What you're going to do is you're going to kill innovation. Things like the vaccines we've just had, and the new pill, before Bayh-Dole, those would have just sat there on the shelf. It's very unlikely they ever would have been developed. Just think about what the costs and not just the economic costs, what would the health cost be? Remember, 18 months ago, maybe I'm the only person who remembers this, our hospitals were being overrun.

In fact, they're still being overrun every time COVID spikes. What would be the benefit to the public and to health workers if 50% of the people going to hospital stayed home and took a pill? That to me is a miracle. To think that we've done that in less than two years is incredible. There's never been a vaccine developed in months as opposed to years until last year. To me, we ought to be having a ticker tape parade for the people that have pulled this off, people like Wendy Holeman, instead of kicking them in the teeth.

**Michael Fitzhugh:** From your perspective at the Bayh-Dole Coalition, do you see any ways in which Bayh-Dole might evolve for the better or change, given more modern circumstances? Are there any aspects in which you think it might be amended or added to in the future?

**Joseph Allen:** I would leave it alone, it's working. In fact, the best evidence it's working is the Chinese have adopted it to compete against us. Basically, when people say, "Well, how would you improve it?" I really can't think of anything. The law is working as it was intended. The benefits have been tremendous. Again, there are two aspects of the problem. Bayh-Dole has focused on if the government funds research, let's make sure it turns into a product, and also, let's make sure that product is made in the United States whenever possible. That's what Bayh-Dole does.

The second part of it is, back to healthcare, why are medicines so expensive? Why are drugs so expensive? That's not a Bayh-Dole issue, that's a much larger issue. What Congress needs to do is address that issue directly. Don't try to put that on Bayh-Dole. Bayh-Dole can't carry that weight, it would collapse the system. It would do no good, we saw that at NIH. What these politicians need to do, as opposed to taking potshots at Bayh-Dole and making up crackpot theories, address the real issue. That's hard to do because it's a really complicated issue. Again, we need to separate those two and say what Bayh-Dole does, it does extremely well.

We are commercializing these technologies, people like Emory have got their heart and soul into this. That passion, the passion that's needed to drive commercialization is only done when it's decentralized, and people have the incentives and the authority, and we get the bureaucracy out of the way. Putting more bureaucracy on Bayh-Dole and having more government oversight and more committees in Washington will frankly kill the golden goose.

Everyone in the world, almost literally, is benefiting because of Bayh-Dole right now. I would say Bayh-Dole is working. Why healthcare is so expensive is a different issue, but it needs to be addressed directly. You can't pile that onto Bayh-Dole.

**Michael Fitzhugh:** Joe, I think that's a good place to leave it. Thank you so much for joining us today. It's been really interesting to talk to you about this. I've certainly learned a lot about Bayh-Dole, and I hope that our listeners have to.

**Joseph Allen:** Well, thank you very much. I've actually enjoyed talking with you.

**Lynn Yoffee:** Thank you both, Joe and Michael, it's really a fascinating story. Joe, you certainly gave us some perspective on that potential $700 price tag when you look at the millions of people who might not have to go to the hospital as a result. As always, *BioWorld* will continue to keep you informed of all the most important scientific, clinical, and business updates in the field. That's our show for today. If you need to track the development of drugs, turn to *bioworld.com*, follow us on Twitter, or email us at *newsdesk@bioworld.com*. Also, if you're enjoying the podcast, don't forget to subscribe. Thanks for joining us.

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