# Dr Chelsea Batty – Cardiac Rehab: Is a Little Encouragement Enough?

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**Prof. Maria Hinfelaar:** Okay, so welcome everybody to the last one of the series, the Glyndwr Talks series or Sgyrsiau Glyndwr in the beautiful Welsh language. Of course we are going to be running the series again next year with no doubt, a very exciting and inspiring range of speakers under a different name and we'll come to that in good in good time and due course. So I'm here to introduce Chelsea Dr. Chelsea Batty who is of course a lecturer in the sports science area with a particular focus on on the links between Sport Science, Health, physio, and tonight's talk is going to focus on post cardiac or cardiac rehabilitation in situations where people have experienced cardiac issues, and how rehabilitation utilising what we know from sports science at all different levels, and how that can help people in that scenario. So I'm really eager to find out and I'll hand over to Chelsea.

**Dr Chelsea Batty:** Thanks Maria. So as Maria said, I'm Dr Chelsea batty. I'm a senior lecturer here at the university and I lecture in exercise physiology. So I'm here to talk to you tonight about cardiac rehabilitation or cardiac rehab and specifically going to talk more about how we can potentially encourage patients to exercise a bit harder in the hopes that that will help them achieve their exercise targets.

So just a bit of background information on cardiac rehab if you're not familiar, so if you are suffering from cardiovascular disease or you have recently had a cardiac related event, such as a myocardial infarction, also known as a heart attack, then most nations across the world will offer you what we call cardiac rehab. Now in the UK that is governed by two bodies, the British Association for cardiovascular prevention and rehabilitation, the BACPR, and the Association of Chartered Physiotherapists in cardiac rehabilitation, the ACPICR and those two governing bodies if you like work hand in hand, to put together guidelines, which suggest this is what patients should do if they are going to be going to cardiac rehab in the UK. We also have the National Audit of cardiac rehab or NACR or NACA, as we call it in the UK, which was put together a few years ago by a team at the University of York. And effectively they do what it says on the tin they audit all the different rehab programmes across the UK. They collect data on how many patients are going to cardiac rehab the types of patients that are going there, the types of staff that are employed in all these different centres across the UK. And they produce an annual report, which is available on their website for anyone to look at.

So in terms of its definition, the World Health Organisation suggests that the current suggests that cardiac rehab is the sum of activities required to influence favourably the underlying cause of the disease as well as to ensure the patient the best possible physical, mental and social conditions so that they may, by their own efforts, preserve or resume when lost as normal a place as possible in the life of the community. So the BACPR, the governing body that I was referring to here at the start. Their six core components constitute the coordinated sum of activities that the World Health Organisation is referring to. But in short, it's a period of supervised exercise training sessions and education sessions.

Now in terms of the pathway of care in the UK, a patient will suffer a cardiac related event such as a heart attack. Their GP will identify that patient and refer them on to the cardiac rehab team, the cardiac rehab team will manage that referral and recruitment. Then in stage two and stage three, they will assess the patient, normally a fitness test is carried out, they'll have a chat with the patient about their risk factors their medication, have a chat with them about their exercise, what to expect when they come to the local leisure centre to carry out that supervised exercise and they will develop a patient care plan. Then in stage four is where the patient will go to their local leisure centre and undergo that period of exercise training under the supervision of the cardiac rehab team. And they'll also be offered the opportunity to attend education sessions as well. Once they finished that period of exercise training, they'll then come back to the cardiac rehab team, they'll do another fitness assessment to see if there's been any improvement, have a chat with them about their long term goals and then transition them into long term management. So the hope is that the patient will adhere to this active and healthy lifestyle that they were sort of doing in in stage four.

A little bit more information about the pre assessment. So this sort of stage here. That fitness test that I talked about. Normally what a patient will do is an intermittent shuttle walk test, it’s very similar to a bleep test. If you're familiar with what that is. Effectively, the patient will walk between two cones nine metres apart, they have to hit that cone in time with the metronome beat. We'll look at how far they've walked in terms of metres overall. So it might be that a patient walks 500 metres okay. We'll also take some other measurements such as their body mass, their height, calculate their BMI, have a chat with them about their risk factors. Their medication and also talk to them about what to expect when they actually go to that Leisure Centre in terms of the exercise component.

Speaking about the exercise component, whenever we prescribe training, exercise training to somebody that doesn't have to be a patient, it could be anybody. We have to do it based on what we call the FITT principles, frequency, intensity, time and type. Now it's the ACP ICR the other governing body that has suggested the guidelines for the exercise components. They suggest a patient should exercise two to three times a week for eight weeks. So we're looking for a minimum of 16 supervised exercise training sessions. The third session is what the patient should be doing in their own time at home. So that's the frequency.

Intensity is how hard do we want the patient to exercise? We can prescribe that based on different means. But the way that cardiac rehab does it is they prescribe it based on a percentage of heart rate reserve or rating of perceived exertion. Heart rate reserve, we can easily work that out. All we need is the patient's resting heart rate, their estimated maximal heart rate and if they're on beta blocker medication if they are how much beta blocker medication are they on. We can then work that range out and it might be something like 115 to 125 beats per minute. Put a heart rate monitor on check the heart rate monitor, are they exercising within that range? Now heart rate monitors are not always available to every cardiac rehab team across the UK. And in some cases, they're not suitable. A patient might have an arrhythmia therefore a heart rate monitor would not pick their heart rates up correctly. So we could use the rating of perceived exertion scale, the BORG 61. Effectively it's a sheet of paper with numbers on it, six being I'm not doing any exercise. I'm laying in bed. I'm having a nap. 20 being I'm exercising maximally please help me. Okay. 11 to 14 is what we would call moderate. So the patient is able to hold somewhat of a conversation, but they are getting breathless. Or we could use the other one which is the cardiac rehab 10 scale. Again, two to four on that is what we would call moderate, so we have the objective way to prescribe intensity and we have the subjective way to prescribe intensity.

Time is the next one. So we want them to exercise at that intensity for a minimum of 20 minutes but the range is 20 to 60. And the type of exercise is cardiovascular and strength. Now cardiovascular could be continuous i.e., get you on a treadmill, continuously jog for 20 minutes or it could be interval. Very stop start. Two Minutes on, two minutes off. And what we do tend to see cardiac rehab teams doing in the UK is adopting that interval style approach in the form of circuit training. So if you're not familiar with what circuit training is, there are different exercise stations in a circular format. So it might be that one of the stations is cycling. The one next to it is bicep curls. The one after the one after the after it is jogging, and so it's very stop start and the patient will switch from different stations going round in a circular format.

So because circuit training is the most common mode of exercise in UK cardiac rehab, I'm going to talk a little bit more about that. So other than the circuit having different stations, it also has different levels. Level one being primarily all seated exercise for a very deconditioned patient who might be quite immobile. So this is why it's important that we do measure their fitness levels at the start, because that gives us an idea on which level of the circuit we need to start them on. On the opposite end of the spectrum, level five is all cardiovascular exercise, maybe for a very high functioning fit patient. Level three would be a mixture of active recovery and cardiovascular based exercise. So the way that the progressive overload principle is manipulated here because we have to manipulate that in order to induce some sort of physiological adaptation, i.e., we want them to improve their fitness, we can't keep them the same stimulus for the eight weeks we need to change something, is we will take away the active recovery stations and we will put more cardiovascular stations in, in the hopes but by the end of the eight weeks, they are doing at least 20 minutes of cardiovascular exercise. Although that exercise is not continuous because they're doing circuit training, it’s still very stopped start, but there's no active recovery stations. Okay. So we're not saying in week one, we want you to exercise at 40% heart rate reserve and then by week eight, we want you to exercise at 70%. We're sort of manipulating the duration that they spend on those CV stations.

Exercise intensity or how hard they're exercising should be monitored throughout because that is key. That is key to any physiological adaptation. It's not how often we exercise it's how hard or for how long. Okay, so it's important that we monitor that. And we can monitor that by using those heart rate monitors or rating of perceived exertion scales or visually, just to check that patients are hitting that target of 40 to 70% heart rate reserve or 11 to 14 on the Borg scale.

So that's pretty much it for what cardiac rehab is and what the exercise dose as prescribed is. I'm now going to talk more about what is the research found in terms of does it actually work. And the first thing we're going to talk about is, does it make you live longer? Does it improve mortality? So we've got a list of studies here that have found Yes, it does. If you undergo exercise based cardiac rehab, it will make you live longer. And we've got some studies that are saying well actually it doesn't the first one I'm going to talk about is this Heron et al. 2011 study that is the Cochrane review that the SCP ICR have based this does on. Okay. And what they found is it does reduce death by any cause and by cardiovascular disease compared to usual care / control group. Now the Anderson et al. 2016 Study was the updated Cochrane Review and what they said was actually, all the studies prior have included outdated trials in their analyses, trials that were conducted in the 60s and 70s. And they've potentially overestimated the efficacy that cardiac rehab has because the difference in patients undergoing cardiac rehab back then to now is the surgical and pharmaceutical treatments. Effectively, if you have a heart attack today, the chances of you dying from it are very slim, because they'll fit you with a stent more or less straightaway and bang you on lots of nice medication, and you're gonna go and live quite a nice long life. So potentially, all those studies have overestimated the efficacy that it has. So Anderson included more up to date trials and excluded outdated ones. And what they found is it does reduce death but only via cardiovascular disease not by any cause compared to a control group.

Now, the Salzwedel study suggested it does reduce death by any cause, but only if the delivery is based on minimum requirements and by minimum requirements, we're talking about the prescribed exercise dose. Now the Dibben et al. is the latest Cochrane Review confirms what Anderson found and Heron and suggested it reduced the risk of a further myocardial infarction, another heart attack and reduced death by any cause compared to a control group. Now all these studies have quite a few things in common, the first one being they're not inclusive to the UK. So the trials included in their analyses are not UK based trials only. They have trials conducted in America, Germany, New Zealand, where they do substantially more exercise as part of cardiac rehab than what we do in the UK. Typically in America, you'll have patients doing twice a week for 15 to 20 weeks, not twice a week for eight weeks. So it could be that what they are finding is correct, but they're doing more exercise. We don't know if the UK dose makes you live longer. Okay.

The other thing that they have in common is that none of them have measured how physically active the patients were at follow up. The only real way to say that cardiac rehab, the exercise, is making a patient live longer is to see if they were actually doing the exercise long term. Because you can't really say that doing an eight week period of exercise or even 15 to 20 weeks is going to make you live longer. So they didn't follow them up. They didn't measure that.

The other thing is that they were very poor on reporting what patients were prescribed to do in terms of the FITT principles and none of them reported what they actually did. Because there's a difference between what you're prescribing somebody to do versus what they actually do. If I said to you, I want you to do 20 weeks of endurance training, go to the gym twice a week. Go on the treadmill 30 minutes, and let's just say 70% of your maximal heart rate. I'll work all that out. How do I know you've gone and done it? The only way to really know if you've gone and done it is for me to be with you every single session, standing next to you on the treadmill looking at your heart rate monitor making notes of the data or have some form of specialised heart rate monitor that would collect the data for me and I can drag it off afterward. None of these studies have measured what they actually did. So we don't know what we call the dose response. We don't know what the dose response is.

Now these studies the West et al., and it’s a UK only study and it's the UK is biggest RCT to date and it was conducted years ago. And what they found is it doesn't make you live longer. Now, again, the trials included in their analyses were generally poor on reporting what patients were prescribed to do. But when they did report it, funnily enough, it wasn't this. Particularly, patients weren't prescribed to do twice a week for eight weeks. Patients were doing once a week for eight weeks, twice a week for six weeks. So you could say, well, no wonder there was no difference in the exercise group and a control group in terms of mortality. They weren't prescribing what they're supposed to be doing. They're not doing enough exercise. So we have somewhat of an idea of what they were prescribed to do. It wasn't that, but again, we have no idea what they achieved. In terms of how hard were they exercising, how long were they exercising for; the main thing is cardiac rehab programmes across the UK are understaffed and underfunded. They can't physically prescribe that dose. So what can we do for these two targets in the sessions that they are prescribed to do, we have to go and monitor.

Now the Powell et al. study suggested again, no effect, in terms of it doesn't make you live longer compared to a control group. Now, comes on to my next point of should we even be looking at mortality as an outcome. The death rate from cardiovascular disease has been on a steep decline since the late 60s. As we can see death rate per 100,000, declining, the incidence rate stayed the same. People are still getting cardiovascular disease, there's just not dying from it. As I've said at the beginning, the prognosis is pretty much very good. They'll fit you with that stent. They'll get you on all these nice drugs. This has massive issues for cardiac rehab teams. They've got more people to rehabilitate when they're already understaffed and underfunded. And also pressures on our national health service to treat these patients. We have this ageing population. People are living longer, but they're living longer in a diseased state. So, should we even be looking at these studies and mortality, should we not be looking at a softer endpoint? For example, fitness.

Now cardiac rehab teams measure patient's fitness levels as part of the programme and fitness is actually an independent predictor of survival. If you can improve your fitness by one metabolic equivalent, which is the same as 3.5 millilitres of oxygen per kilogramme of your body mass. So when we measure fitness we want to see how much oxygen you can consume from the atmosphere and utilise in your body for energy transfer. 3.5 is that clinically meaningful cut-off, and it's the same as one MET. If you can improve your fitness by that, that is related to a 10 to 15% improvement in survival. So let's look at the softer endpoint of fitness. Some studies have measured that.

Now the first one is the Sandercock et al. 2013 study UK only study. 0.5 to MET improvement in fitness was an improvement but it's not clinically meaningful. It's below that one MET improvement that we like to see. Very similar to the West et al. study in that it was generally poor on reporting what patients were prescribed to do. And when it did report it again, it wasn't this. They definitely didn't report what they achieved. So you could say, well, no wonder they didn't have a clinically meaningful improvement in fitness. They're not doing 16 sessions. They're only doing 10. They're only doing 12. Now Sandercock and colleagues also did another study in the same year in the form of the meta analyses. They included lots of different trials conducted all over the world, particularly in America. And they did find a clinically meaningful improvement in fitness, a 1.55 MET improvement in fitness. But again, you could say well, they did more exercise in that trial. They're doing 20 30 40 sessions of exercise, whereas in the UK, we're supposed to be doing 16 but in reality, we're probably doing eight or 10 Because cardiac rehab programmes can't prescribe the full dose because they're understaffed and underfunded.

Now the Alhmody study a UK only study again, suggests that we shouldn't be using the shuttle walk data, the test data, the fitness test data in terms of how far they've walked in terms of metres and converting it into METs because there's no agreed way to do that. There's lots of different equations you can use. Instead, we should be looking at effect sizes. So if you're not familiar with effect sizes, the closer that number is to one and higher, the bigger the effect, the closer is to zero, no effect. So 0.48 moderate effect and moderate improvement in fitness. They did convert it to METs but they offered a range because they use different equations 0.68 to 0.8. So below that clinically meaningful number of one that we like to see.

Now the Kushhal et al 2020 study is a UK only study. And they are the study that I'm going to talk more in detail about in a little while but they actually did go in and monitor what patients did. Because by that point by 2020, they'd realise there's lots of studies that have looked at cardiac rehab, but we don't know what the dose response is. We need to actually go and audit. Go to all the sessions and monitor stuff like how hard they're exercising for how long, how many sessions are the attending. But for now, they found a 0.9 MET improvement in fitness again below that clinically meaningful cut off of one, UK on this study as well.

So what we've established up to now is we don't know what's going on because what you prescribe is not the same as what the achieve. Yeah. Which is what Powell commented on in 2018. In their review, they say that one major concern is the reporting of adherence to and fidelity of exercise interventions. While the majority of studies included in this review report the intended prescribed exercise dose, it is not possible to determine adherence and fidelity without basic reporting of these parameters, the actual exercise dose received cannot be quantified. This may have a significant bearing on intervention. So fidelity effectively means, is the programme carried out as intended. Up to Kushhal’s study, we didn't really know we kind of knew what was prescribed it was generally poor. We know that it wasn't two times a week for eight weeks, and we have no idea what they achieved. And just to give you an idea of the scope of the lack of fidelity reporting, these are all the individual studies taken from the Anderson Cochrane review. And you can see the nation in which they took place, the exercise intervention prescribed based on the FITT principles, and did they report what was achieved we still have a lot of unknowns here because as I said, it was generally poor. But there's a lot of no’s there. We don't know what they were doing.

So, I decided, as part of a study I did a few years ago, we're gonna go and look at that. Because we want to know what they're doing. So we worked with a cardiac rehab team in Leeds, in West Yorkshire and we went in and we monitored the fidelity of the programme. Now, we were particularly interested in exercise intensity, how hard these patients were exercising because that is key to any physiological adaptation, improvement in fitness. Now, like many studies that have that have shown this, they weren't able to prescribe two times a week for eight weeks, because understaffing and underfunding and as a researcher, there's not really much I can do about that. I haven't got a magic money tree. If I did, I'd obviously pick them off and say, Please spend the money on prescribing a full dose. The only thing we can really do is ensure the sessions that our patients that patients are doing is ensuring that they are hitting those intensity and duration targets. Okay. So we went in, in week one, week three, week six, start middle end of these patients six week programme. And what we found is they were hitting the intensity target but more towards the lower range, 42% in Week 1, 48% middle, 48% end, of heart rate reserve. We also looked at their shuttle walk test, and before they started rehab they were walking 440 metres. At the end they walked 633. And you'd say Well, yeah, it's good that they've definitely improved their fitness. No.

Distance walked is not a metric of fitness. What we have to do is either convert it into METs or we have to calculate what we call the heart rate walking speed index, that gives us an indication on if there has been some sort of physiological adaptation to the heart. i.e., is the heart more efficient? Is it able to pump less at the same level of that shuttle walk test at the end compared to before, now that data is not available in the write up, but I calculated it after the fact and there was no improvement in the heart rate walking speed index, therefore, that improvement there is probably due to a learning effect because they don't have a practice of this test. How could they, they can't prescribe a full dose, they can't bring patients in for a pre-practice test. We also looked at some other metrics. Frequency Yes, they did do two times a week for eight weeks for two times a week but they didn't do it for eight weeks. So the volume wasn't met. Intensity was met, time though, they weren't able to exercise at that intensity for a minimum of 20 minutes. And that's what matters. Okay.

The type, yes they did do circuit training. As I mentioned before, it wasn't eight weeks, it was only six. And attendance. We didn't report that. Again, I'm just critiquing my own study here. But what we did say is patients had to attend 80% of their sessions to be included in the analysis. So 10 out of 12. Okay. So you could say, Well, no wonder there was no physiological improvement there. They weren't doing two times a week for eight weeks and they didn’t exercise for 20 minutes minimum, because that is the minimum at 40 to 70% heart rate reserve.

Now this study, very interesting, the Nichols et al., study is the only study to date that is found when you prescribe the dose as intended, and when patients achieve it as intended, it doesn't work. Doesn’t improve your fitness. So patients did do two times a week for eight weeks. They did exercise within 40 to 70% heart rate reserve for 20 minutes, they did do circuit training. They measured their fitness via a cardiopulmonary exercise test rather than a shuttle walk test, which is the gold standard way to measure fitness. But it's very expensive equipment and it's very time consuming. So very likely to occur in the research world but in the real world of cardiac rehab in the leisure centre, you're going to be seeing shuttle walk tests, but nonetheless, they measured the fitness, 23.5 millilitres of oxygen consumed and utilised in the body prior to cardiac rehab. Remember, we’re looking for a 3.5 millilitre per kilogramme improvement because that is clinically meaningful. That's related to the survival improvement. And after rehab, it was 23.8, 0.3 improvement and not statistically significant. I will emphasise it's the only study. So you can't put all your eggs in one basket just based on this. Yeah, but interesting nonetheless.

Now I did say I'd come back to the Kushhal study. So again, like Nichols and like myself and colleagues, they wanted to go and see what patients were doing in cardiac rehab. So they monitored it. They were able to prescribe two times a week for eight weeks, however. So they looked at how long patients were exercising for, were they exercising for 20 minutes. Yes, more or less throughout the eight weeks. Were they exercising within 40 to 70% heart rate reserve? No. So you could say well, why were patients in this study able to achieve it? And why were patients in this study not? I'll come on to that in a second. But for now as prescribed and achieved, all patients attended 100% of the sessions in the Kushhal study. They did do twice a week for eight weeks. They did exercise for 20 minutes, but they didn't exercise for 20 minutes at 40 to 70% heart rate reserve, hence why there was no clinically meaningful improvement in their fitness. 0.9 MEts below that one met improvement. Okay.

So in terms of why did they exercise and hit that target in that study, and not in the Kushhal study, what's the main difference? Well, it could be due to the fact, or due to the way the circuit is actually set up. Because in the Nichols study, in their initial published protocol, they said that they were going to let patients exercise for longer. Normally, on each station, a patient will be on it for two minutes before the whistle blows and you move on to the next station. Nicols said we might give patients three or four minutes, Kushhal didn't mention anything about this. So it could be that those patients have longer because two minutes in reality is not enough time to get the heart rate up. I visually witnessed lots of patients taking at least a minute to get on the bike, strapped themselves in. They have one minute, the whistle blows, move on. I've had patients staring at cards because there are cards positioned all around the room, in the leisure centre telling the patient what size they need to do staring at it, what’s a bicep curl. And they could be staring at that for 45 seconds. And that's time gone. The instructor’s too busy with the 15 other patients in the class. So in reality, they're not getting enough time on the stations to get the heart rate up. So that could be the reason why the Kushhal study they couldn't achieve it but in the Nichols, they could.

In terms of what else we could do to help patients achieve that intensity target because that is key to that physiological adaptation is rather than giving them more cardiovascular exercise and taking away the active recovery, we should potentially be manipulating the exercise intensity variable. So the progressive overload principle is manipulated by potentially starting them off at 40% heart rate reserve in week one, pushing them up to 70% in week eight, we don't do that at the minute. As I mentioned, we take away active recovery stations, we put in more cardiovascular in the hopes that by week eight, they're doing 20 minutes of cardiovascular exercise at 40 to 70% heart rate reserve, so that might allow them to hit that target.

We also work out percentage heart rate reserve by estimating a patient's percentage maximal heart rate. The formula that we use has 10 to 15 beats per minute degree of error either side. Patients might not even be exercising hard enough to see any physiological adaptation in their fitness. The only way to directly measure somebody's maximal heart rate is through a cardiopulmonary exercise test. But as I mentioned, that equipment is very expensive. It's very time consuming, probably not going to be feasible for cardiac rehab teams to do when they're already understaffed and underfunded. We also need to make sure we're calculating the heart rate walking speed index during that shuttle walk test because that gives us an idea of if that improvement in distance walked is down to a physiological improvement. Monitor them. Something as simple as that. Maybe, as I said, you've got patients staring at cards not really knowing what that exercise is. Maybe the instructor just needs to be a bit more on the toes and making sure that patients are knowing what they're doing on time. And potentially combining that with verbal encouragement, which is what we did.

We wanted to do something that would be feasible, that potentially the cardiac rehab team could employ long term when the researchers had gone. As I said, we can't give them money to do eight week, two sessions a week for eight weeks. They're only doing two sessions a week for six weeks. So what can we do to ensure that those 12 sessions that they are doing they are hitting that intensity target for the correct amount of time .We wanted to test whether verbally encouraging them would be sufficient. So I'm particularly interested in total exercise time between 40 to 70% heart rate reserve, we have a group not receiving encouragement, and we have a group receiving encouragement. Now again, we went in week one, week three, week six, start middle end, and we monitored them and we encouraged them. So in the group not receiving encouragement, they're sort of nowhere near that 20 minutes minimum, 14 minutes, 15 minutes, 12 minutes; but in the group receiving encouragement, 12 minutes 14 And then 18.6. So there's a trend towards them potentially maybe being able to hit that 20 minutes, but we only really encouraged them three sessions out of 12. So you don't really know what they're doing in their other sessions. But unfortunately, it wasn't enough, and there was no statistical difference between the two groups, and no statistical difference in their fitness levels between the two groups. Now there is issues in the fact that the sample sizes are completely irregular. And it's something that probably needs to be tested out by more sufficiently powered, randomised controlled trial. But unfortunately, it didn't work in this case.

So, I'm gonna bring it all back round. In terms of a summary, research showing exercise based cardiac rehab makes you live longer is mostly outdated and includes trials that were conducted overseas where they do lots more exercise anyway. Research showing exercise based cardiac rehab improves your fitness was conducted overseas, where they do more exercise. Most research conducted in this area up until 2019 did not report exercise fidelity and was poor on reporting the prescribed exercise dose. Research has shown UK cardiac rehab programmes cannot prescribe a full dose of exercise and even when the full dose is prescribed, patients are not achieving 20 minutes at 40 to 70% heart rate reserve, therefore, no improvement in fitness or survival. Verbal encouragement did not work. So we must look at alternative means. And I have some ideas but those projects are in the pipeline. So that's pretty much it from me. So I'm happy to take any questions.