

**Ergonomics Research Techniques**

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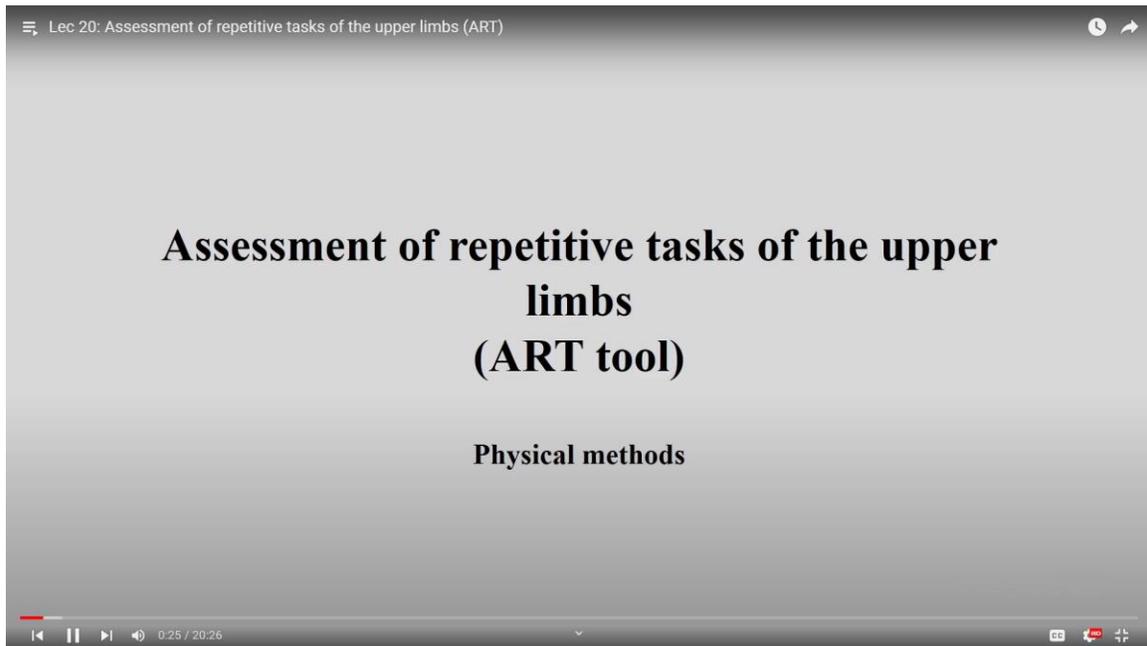
**Department of Design**

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**Week – 06**

**Lecture - 20**

**Lec 20: Assessment of repetitive tasks of the upper limbs (ART)**



Welcome back. Today we will be talking about another tool which is more describe which is just going to describe about our upper arm.

Lec 20: Assessment of repetitive tasks of the upper limbs (ART)

## Introduction

- Given by Health and Safety Executive(HSE) which assesses the tasks that require repetitive movement of the upper limbs.
- Helps in assessing some of the common risk factors in repetitive work that contribute to the development of upper limb disorders.
- Useful to employers, safety representatives, health and safety practitioners, consultants and ergonomists

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So, the name of the tool is assessment of repetitive task of the upper limb that is ART tool. Again this tool is given or introduced by health and safety executive which assess the task that requires repetitive movement of the upper limb. It helps in assessing some of the common risk factors in repetitive work that contribute to the development of upper limb disorder. This particular tool is very useful to the employers, safety representatives, health and safety practitioners, consultants and of course, ergonomist.

Lec 20: Assessment of repetitive tasks of the upper limbs (ART)

## Introduction

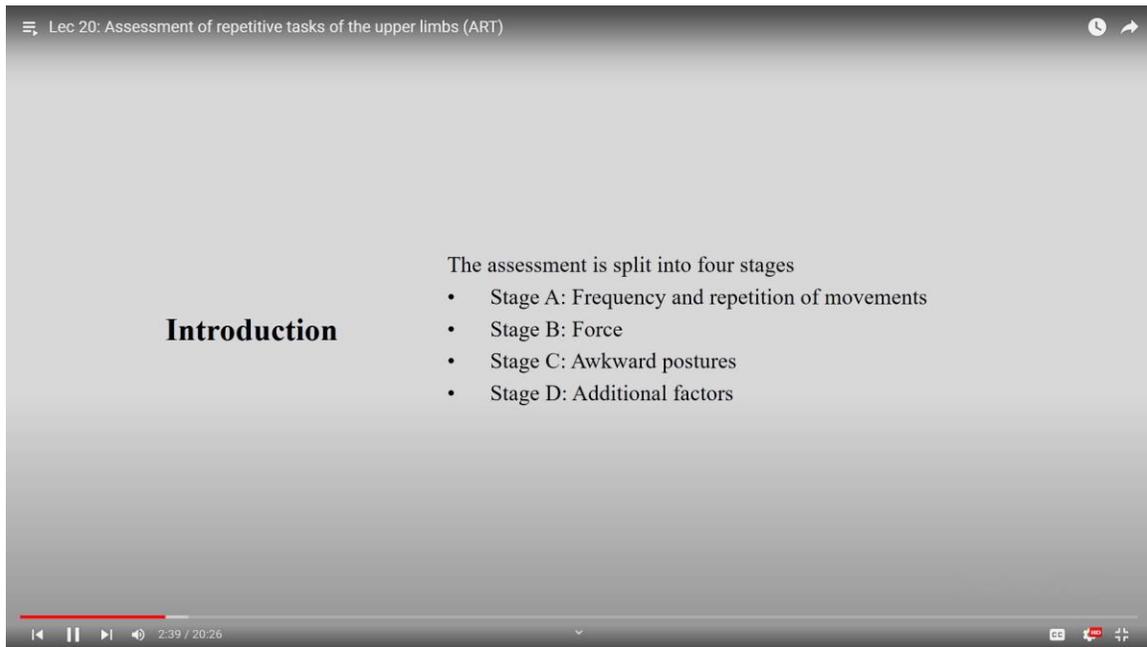
- Repetitive tasks are made up of a sequence of upper limb actions, of fairly short duration, which are repeated over and over again, and are almost always the same.
- ART is most suited for tasks that
  - involve actions of the upper limbs
  - repeat every few minutes, or even more frequently
  - occur for at least 1–2 hours per day or shift

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So, this tool is going to assess the risks or hazards which is going to present in any workplace condition where upper arm or arm is associated with any kind of repetitive

movement. So, repetitive tasks are made up of a sequence of upper limb actions of fairly short duration. Now here you may ask what is the kind of short duration I am talking about. Therefore, I suggest that IEA has given a definition of repetitive task, you should follow the definition of repetitive task given by IEA which are repeated over and over again and are almost always the same.

So, ART is most suited for task that involves actions of the upper limb, repeat every few minutes or even more frequently occur for at least 1 to 2 hours per day of a particular shift. So, if these conditions are present then we can use this particular tool ART.



The screenshot shows a video player interface. At the top, the title is "Lec 20: Assessment of repetitive tasks of the upper limbs (ART)". The main content area displays the word "Introduction" in bold on the left. To its right, a text line reads "The assessment is split into four stages", followed by a bulleted list:

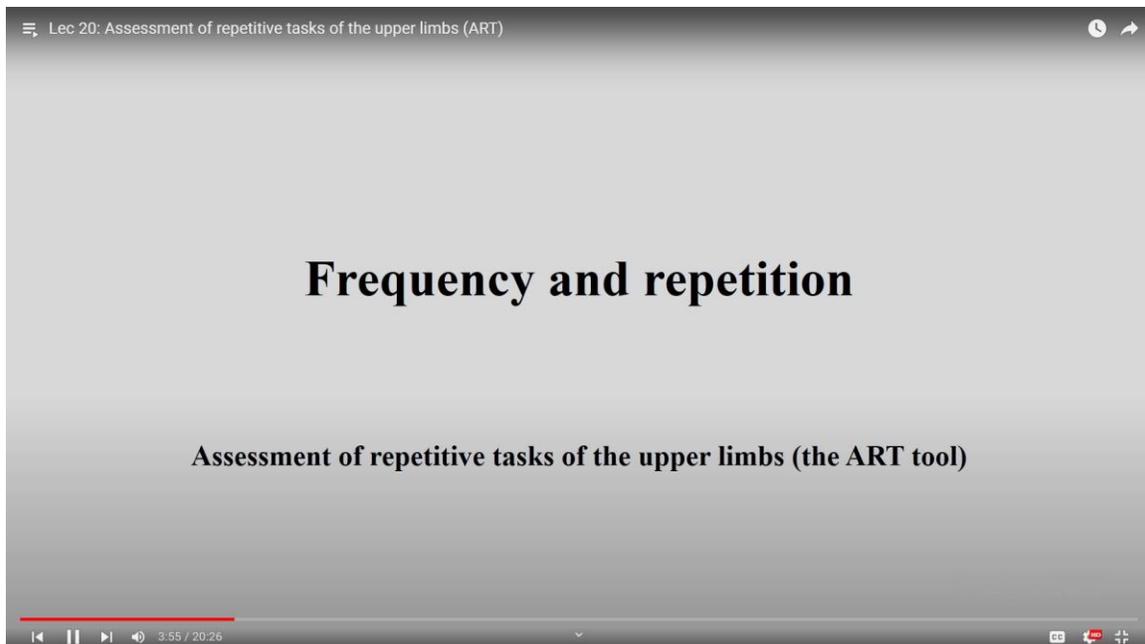
- Stage A: Frequency and repetition of movements
- Stage B: Force
- Stage C: Awkward postures
- Stage D: Additional factors

The video player controls at the bottom show a progress bar at 2:39 / 20:26, along with standard playback icons.

This particular assessment is splitted into 4 major stages. First stage talks about frequency and repetition of movement, second stage that is the stage B talks about force, then next is awkward posture that is the stage C and the additional factor that is the stage D. So, these are the color coding that we are going to use.



I believe you remember the color coding what we used for MSE. Similar color coding is being used here as well. G that is the green we are also we call it as low level of risk. A amber or medium level that is the examine the task closely. So, there is some risk so you examine it and R that is the red or high level of risk you need to have a prompt action as soon as you get these results.



So, this is the color coding we are going to use this particular tool. Now let us understand one by one. We are talking about frequency and repetition. So, assessment of repetitive task of the upper limb and we are talking about the frequency and repetition. Here you have some factors.

Lec 20: Assessment of repetitive tasks of the upper limbs (ART)

## A1 Arm movements

		L	R
Arm movements are	Infrequent (eg some intermittent movement)	0	0
	Frequent (eg regular movement with some pauses)	3	3
	Very frequent (eg almost continuous movement)	6	6

- Observe the movement of the arm

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First is your arm movement or we will call it as A1. So, these A1, B1, C1 all these terminologies that you know that coding you need to remember or you need to use it as it is described in this tool because the flow chart or the data collection chart follows the same nomenclature. So, you cannot do the changes. So, you have to say that capital A1 you cannot write it as small a1 or maybe x1, b1 no not like that. So, you have to use the same nomenclature that is present in the tool.

What A1 is or arm movement is? Arm movement is categorized into three major area that is green, amber and red both for left hand and right hand. You have a definition. So infrequent some intermittent movement. So, then it is 0. Frequent regular movement with some pauses then it is 3, value is 3 and color is amber and very frequent that is the almost continuous movement value is 6 and color is red.

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## A2 Repetition

		L	R
Similar motion pattern of the arm and hand is repeated	10 times per minute or less	0	0
	11–20 times per minute	3	3
	More than 20 times per minute	6	6

- Observe the movement of the arm and hand but not the fingers

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So observe the movement of the arm for a particular shift for a particular duration and from there you should have this particular scoring system or scoring value. Under stage A you have arm movement and you are talking about repetition. So frequency and repetition. So now here we are talking about 10 times per minute or less than that then for both arm left and right it is 0, color is green. 11 to 20 times per minute that is value is 3 and color is amber and more than 20 times per minute that is color is red and value is 6. So what we are talking about? Similar motion pattern of the arm and hand which is going to repeat over and over again.

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## Force

### Assessment of repetitive tasks of the upper limbs (the ART tool)

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Description of the level of force exerted with the hand

**B Force**

Light force	There is no indication of any particular effort
Moderate force	Force needs to be exerted
Strong force	Force is obviously high, strong or heavy
Very strong force	Force is near to the maximum level that the worker can apply

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Now the second stage is all about force. Here also you have some kind of category and definition. So you have four major categories, light force, moderate force, strong force and very strong force and you have description of these categories. Light force talk about there is no indication of any particular effort.

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**B Force**

	Light	Moderate	Strong	Very strong
Infrequent	G0	A1	R6	Changes required*
Part of the time (15-30%)	G0	A2	R9	Changes required*
About half the time (40-60%)	G0	A4	R12	Changes required*
Almost all the time (80% or more)	G0	R8	Changes required*	Changes required*

- Worker's description of the level of force exerted with the hand

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Light force talks about force needs to be exerted. Strong force, force is obviously high, strong or heavy and very strong is force is near to maximum level that the worker can apply. So you can have the color and the values. So if we are talking about infrequent

then it is the G0 green and then it is a combination. So workers description of the level of force extended with a particular hand.

So how part of the time 15 to 30 percent about half of the time they are exerting then 40 to 60 percent almost all the time that is the more than 80 percent then it is the value is you have to calculate. So here everything is green that is G0, A1, A2, A4, R8 that is the moderate and then R6, R9, R12. So this is like the kind of coding. So you can see if it is infrequent and light then G is 0. Part of the time then it is G0.

Whereas if you are the part of the time but moderate then value is A2. So using this particular matrix you have to decide that for force what value you have. So first what you do, first you have to select what is the kind of force they are going to use and then you have to see at what frequency they are using it. Based on the amount of force and based on the frequency of utilization of the force you will get the force value, value and color. Now awkward posture.

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**C1 Head/neck posture**

	In an almost neutral posture	<b>0</b>
	Bent or twisted part of the time (eg 15–30%)	<b>1</b>
	Bent or twisted more than half of the time (more than 50%)	<b>2</b>

- Observe the bent or the twist of the neck

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Now awkward posture for your head and neck and also for trunk. So you can see that how the description from the photograph you can see in an almost natural or neutral posture then it is 0. Bent or twisted part of the time then it is 1 and bent or twisted more than half of the time then it is 2.

## C2 Back posture

	In an almost neutral posture	0
	Bent forward, sideways or twisted part of the time	1
	Bent forward, sideways or twisted for more than half of the time	2

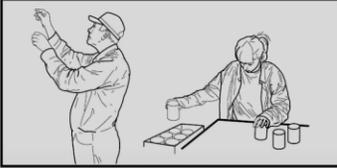
- The back posture is considered awkward if more than 20° of twisting or bending is observed.

For back also similar kind of definition and you can see how it is being described. Bent is forward bending, twisting is on this side, left side or right side or bending is also left side and right side.

So you can have the value. So here it is mentioned the back posture is considered awkward if more than 20 degree of twisting or bending is observed. So this is only a gross identification of your posture. Also you have arm posture. So kept closer to the body or it is supported then for left and right it is 0.

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### C3 Arm posture



	L	R
Kept close to the body or supported	0	0
Raised away from the body part of the time	2	2
Raised away from the body more than half of the time	4	4

- Observe the elbow position

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Raised away from the body part of the time then it is 2 and raised away from the body more than half of the time then it is 4. So observe the elbow position and give this particular scoring. Now is arm posture. It is done.

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### C4 Wrist posture



	L	R
Almost straight/in a neutral position	0	0
Bent or deviated part of the time	1	1
Bent or deviated more than half of the time	2	2

- Observe the considered wrist is bent or deviated.

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Now is wrist posture. Wrist posture again talks about almost straight in a neutral position. bent or deviated part of the time and bent or deviated more than half of the time. So 0, 1, 2 both left and right hand. Hand and grip. So power grip do not grip awkwardly then it is 0.

### C5 Hand/finger grip

	L	R
Power grip or do not grip awkwardly	0	0
Pinch or wide finger grip for part of the time	1	1
Pinch or wide finger grip for more than half of the time	2	2

- Observe the hand or fingers holding an object.

Pinch or wide finger grip for part of the time then 1. Pinch or wide finger grip for more than half of the time then it is 2. So the similar kind of rating that you do for other scoring. So here also you can see the example.

This is very easy to hold. Whereas if you are talking about holding this it takes lot of pressure right. So that is why this is on the higher side. So this is C5. So under C you have C1, C2, C3 and C5. We need to consider some additional factors in this particular tool.

## Additional factors

Assessment of repetitive tasks of the upper limbs (the ART tool)

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The worker performs the task continuously, without a break.

### D1 Breaks

Less than one hour, or there are frequent short breaks (eg of at least 10 seconds) every few minutes over the whole work period	0
1 hour to less than 2 hours	2
2 hours to less than 3 hours	4
3 hours to less than 4 hours	6
4 hours or more	8

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First is we will be denoting all these other factors as D and first factor that is the break we will be taking it as D1. So what it says? 0 means less than 1 hour or there are frequent short breaks every few minutes over the whole period then it is 0. 1 hour to less than 2 hours to 2 to less than 3 hours then 4, 3 hours to less than 4 hours it is 6 and more than 4 hours then it is 8. So this is all about break.

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### D2 Work pace

Not difficult to keep up with the work	0
Sometimes difficult to keep up with the work	1
Often difficult to keep up with the work	2

- Interact with the workers about any difficulties they might have keeping up with the work.

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Now these are all other factors. You had you considered the break. Now you are talking about the work pace. At what pace you are working. Not difficult to keep up with the work.

So 0. Sometimes difficult to keep it up with the work then it is 1 and often difficult to keep up with the work then it is 2. So interact with the workers about any difficulties they might have keeping up with that particular work. So this particular information you should gather from the worker. Some more factors if you see some more interrupting factor or influencing factor is present or nothing is present then 0.

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**D3 Other factors**

	L	R
No factors present	0	0
One factor is present	1	1
Two or more factors are present	2	2

- Observe for other factors that are present in the task like
  - Hand/arm exposed to vibration
  - Inadequate lighting levels
  - Gloves affecting the gripping, etc.

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If one factor then 1. If two or more factors then it is 2. Here we need to see observe for the other factors that is the hand arm are exposed to the vibration or not inadequate lighting or not gloves affecting that gripping or not or any similar kind of interrupting factors. So from the observation you can decide on. So that is the other factors.

**D4 Duration**

Duration of task by a worker	Duration multiplier
Less than 2 hours	X 0.5
2 hours to less than 4 hours	X 0.75
4 hours to 8 hours	X 1
More than 8 hours	X 1.5

- Observe the time that a worker performs the repetitive task in a typical day or shift (excluding breaks).

Last is D4 that is the duration. Here you have a multiplier. If less than 2 hours this whole thing is happening then multiplier is 0.5, 2 to 4 then 0.75, 4 to 8 then 1 and more than 8 it is 1.

5. So this you need to see from your observation. So what it says the observe the time that a worker performs the repetitive task in a typical day or shift excluding the break because break you considered earlier as a D1 factor. Now this is D4. So if you consider again break it will be repetition. So you are excluding the break and then you are getting this timing included.

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## D5 Psychosocial factors

- Psychosocial factors are not given a score.
- They should be recorded on the score sheet based on the observations and discussions with the worker.

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So this is the multiplier. Next is D5 that is the psychophysical factor. So psychophysical factors are not given any kind of score it is only a consideration. They should be recorded on the score sheet based on the observation and discussion with the workers. So it is not having any kind of scoring system.

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## Score sheet

**Task score**  
The scores entered on the score sheet are added together to generate the task score.  
Task score =  $A1+A2+B+C1+C2+C3+C4+C5+D1+D2+D3$

**Exposure score**  
The task score is adjusted to reflect the total duration that the task is performed by a worker.  
Exposure score = Task score x Duration multiplier(D4)

5 seconds

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So it is only to report in the whole process. Now let us understand how the score sheet can be calculated and how you will use this particular scores. So if you are talking about a particular task so before starting this particular method you have to select a task and you have to give the scoring. So the task score will be all the addition of the values the scores that we know given during our data collection. So A1 plus A2 plus B plus C1,

C2, C3, C4, C5 plus D1, D2 plus D3. So all these values that you are you know the scores that you have collected during your data collection or ticked in your data collection you have to sum it up.

So that is all about the task score. Whereas exposure score is the multiplication of the duration multiplier with the task score. So whatever task score you are getting here you need to multiply that task score with the duration multiplier. That is the exposure score and this particular exposure score only we are going to understand or interpret using the scale. Using that particular scale we have a scale.

Exposure score	Proposed exposure level	
0-11	Low	Consider individual circumstances
12-21	Medium	Further investigation required
22 or more	High	Further investigation required urgently

So let us understand the scale. So exposure score if it is 0 to 11 then we say the exposure level is low and consider individual circumstances. So maybe there are some values which is causing little higher so maybe at that individual level you can check and you can give the small solution. If it is 12 to 21 we will be calling at medium and further investigation is required. Interpretation says that further investigation required and if it is more than 22 or 22 then it is high.

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**Score sheet**

Risk factors	Left arm		Right arm	
	Colour	Score	Colour	Score
A1 Arm movements				
A2 Repetition				
B Force				
C1 Head/neck posture				
C2 Back posture				
C3 Arm posture				
C4 Wrist posture				
C5 Hand/finger grip				
D1 Breaks				
D2 Work pace				
D3 Other factors				
Task score				
D4 Duration multiplier		X		X
Exposure score				
D5 Psychosocial factors				

So you should start the investigation immediately. So that is the interpretation of the scores which we are getting over here. So that is how we interpret the ART tool. So this is how the score sheet look like. You can give the color values here and score values here. So you can get the total value here, you can get the multiplier then you get the exposure score and only the psychophysical factors you can mention here.

You just mention it. There is no scoring for psychosocial factors. This is how the flow chart will look like. So you can either use this if you remember but I suggest you use this for your data collection Once you collect data, you will use this scoresheet to calculate the score value. So this is how you should know you will get everything here.

So that is also possible. This is very easy, very very easy tool and easy to learn, easy to implement. So that is all for this tool. You can see the advantages and disadvantages are quite similar as for our MSC tool like wherever you have upper arm which is involved with repetitive task you can use this tool. Whereas if you have any tool which is not connected to, your repetition is not there for your upper arm then you cannot use this tool. Also learning time is very short so anybody who is having minimum understanding of ergonomics they can collect the data.

However, for interpretation and further intervention you need detailed understanding of ergonomics. That is all for ART. So we will take this particular tool RAPP in our next class. Thank you.