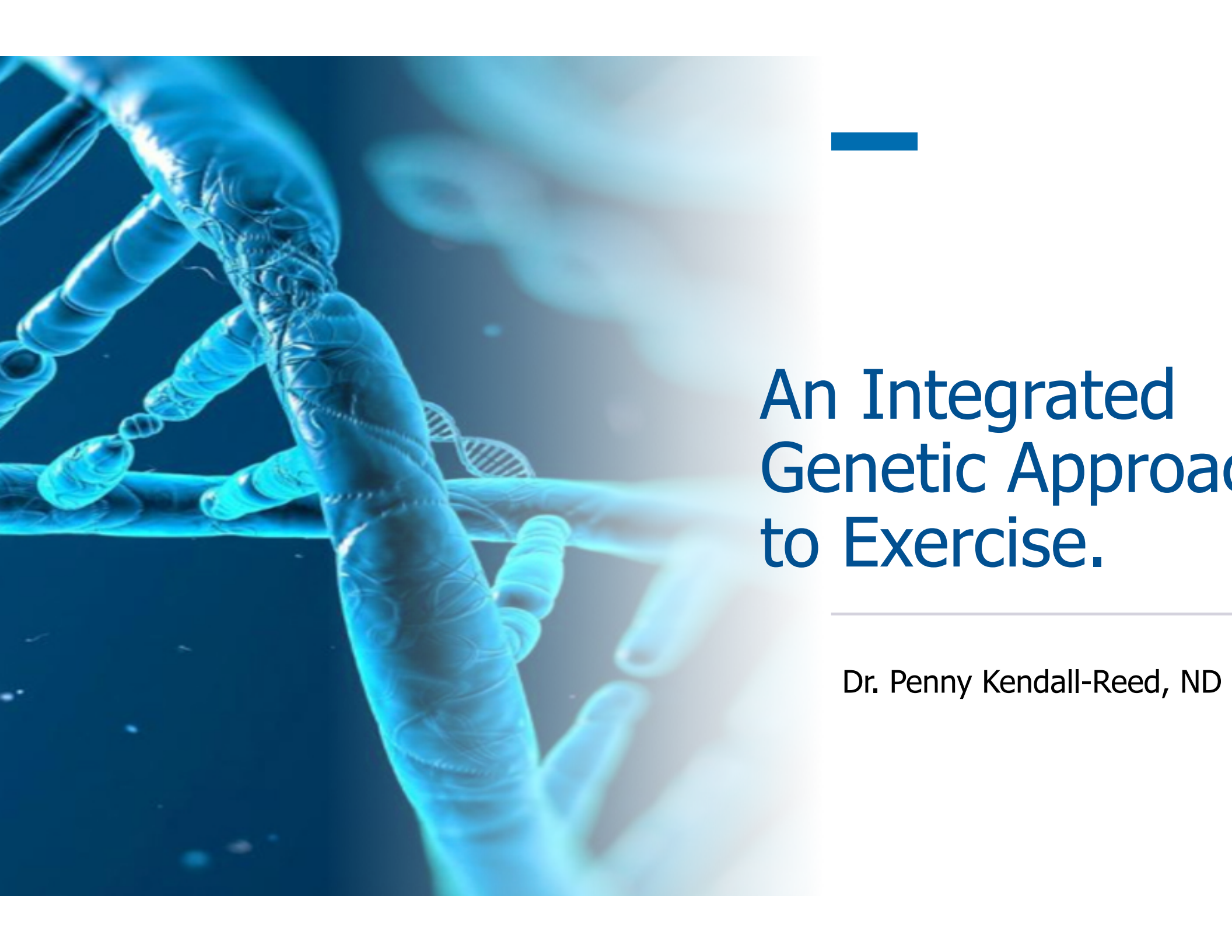




An Integrated Genetic Approach to Exercise.

Dr. Penny Kendall-Reed, ND

Genetics and Exercise.

- ❑ Accounts for 50-60% of athletic performance.
- ❑ Aerobic fitness accounts for 40-50%
- ❑ Muscle fiber type – fast vs slow twitch is 68% heritable.

❑ *S Roth, Genetic Primer for Exercise Science and Health, University of Maryland*

Exercise Genes

- ❑ ACE rs4343
- ❑ ACTN3 rs1815739
- ❑ ADRB2 rs1042713
- ❑ INSIG2 rs7566605
- ❑ IL6 rs1800795

ACE rs4343



ACE rs4343

- ❑ Normal Allele= G Variant Allele =A
- ❑ Angiotensin converting enzyme production.
- ❑ ADH and aldosterone production.
- ❑ Sodium –potassium regulation.
- ❑ Increases production of noradrenaline and ADH.
- ❑ All designed to control blood flow.
- ❑ Eur J Appl Physiol 82, 117-120. doi:10.1007/s004210050660 (2000)
- ❑ Medicina (Kaunas) 47, 284-290. (2011)

ACE and Exercise

Normal Allele G

- ❑ Increased ACE production.
- ❑ Increased vasoconstriction for short bursts of blood flow across the muscle.
- ❑ Better electrolyte control for HIIT.
- ❑ Increased IL6 with endurance.
- ❑ Better with HIIT.

Variant Allele A

- ❑ Decreased ACE production.
- ❑ Increased vasodilation for longer slower delivery of blood to muscle.
- ❑ Less sodium-potassium control for intense exercise.
- ❑ Increased CK production with HIIT
- ❑ Better with endurance workouts.

Support for Ace

Normal Allele G

- ❑ Advantage with sprints or HIIT style cardiovascular work with more intense bursts of energy.
- ❑ Negligible strength gains when using multiple low weight sets.
- ❑ Requires heavier weights with few reps, power type exercises.

Variant Allele A

- ❑ Endurance cardiovascular exercise - 45 mins to 1 hour at 55-75% capacity
- ❑ Endurance style resistance training, multiple reps with lower weights with minimal breaks in between exercises.
- ❑ Do strength training and cardio on the same day.
- ❑ Use compound movements (more than one body part).
- ❑ Electrolytes.

ACTN3 rs1815739



ACTN3 rs1815739

- ❑ Normal Allele=C Variant Allele= T
- ❑ Production of Alpha Actin 3 Protein.
- ❑ Production of fast twitch fibers.
- ❑ Myelin sheath around nerves with slower nerve impulses from brain to muscle.
- ❑ Metabolic byproducts.
- ❑ *Am J Physiol Cell Physiol* 295, C897-904 (2015). *PLoS Genet* 11, e1004862, doi:10.1371/journal.pgen.1004862

ACTN3 and Exercise

Normal Allele C

- ❑ Abundant fast twitch fibers.
- ❑ Thick myelin sheath.
- ❑ Lactic acid as main metabolic bi-product.
- ❑ Better with HIIT.

Variant Allele T

- ❑ Abundant slow twitch fibers.
- ❑ Thin myelin sheath.
- ❑ Carbon dioxide and water as main metabolic bi-products.
- ❑ Better with endurance workouts.
- ❑ Increased DOMS, cortisol and CK with HIIT.
- ❑ *J Appl Physiol* 2014
- ❑ *Appl Physiol Nutr Metab* 2012

Support for ACTN3

Normal Allele C

- Traditional High Intensity Interval Training – 20-30 sec sprints at near max capacity followed by 15 seconds slow recovery (20%), repeat cycles.
- Tuck Jumps. (2x6)
- Rocket Jumps. (2x6)
- Lunge Jumps. (2x6)
- Line Hops. (2x8)
- Skips For Height. (3x30 meters)
- Skips For Distance. (3x30 meters)
- Straight Leg Bounds. (3x30 meters)

Variant Allele T

- Longer slower endurance exercise. (45 mins to 90 mins)
- Longer slower intervals – 2 to 3 min sprints at 70% capacity with 1 to 1.5 min recovery at 50% capacity.
- L-glutamine

ADRB2 rs1042713



ADRB2 rs1042713

- ❑ Normal Allele= G Variant Allele=A
 - ❑ Beta-2-adrenergic receptor that binds catecholamines.
 - ❑ Abundant in the bronchial smooth muscle to increase dilation.
 - ❑ In cardiac myocytes and vascular smooth muscle cells to increase heart rate, vasoconstriction and force of contraction.
-
- ❑ *Am J Physiol Cell Physiol* 295, C897-904 *PLoS Genet* 1004862 (2015).
 - ❑ *Medicine & Science in Sports and Exercise*, 38(5):882-886 2006
 - ❑ *Exercise and Sport Sciences Reviews*: 2008 vol 36-issue 2 p 98-105

ADRB2 and Exercise

Normal Allele G

- ❑ Increased receptors.
- ❑ Increased bronchodilation and vasoconstriction for short bursts.
- ❑ Increased stroke volume for short bursts.
- ❑ Better with HIIT.

Variant Allele A

- ❑ Fewer receptors.
- ❑ Increased bronchoconstriction and vasodilation during intense exercise.
- ❑ Lower stroke volume
- ❑ Lower blood pressure
- ❑ Increased VO2 max
- ❑ Ideal marathon runner

Support for ADBR2

Normal Allele G

- ▣ Sereniten Plus.
- ▣ Ashwagandha.
- ▣ Deep slow breathing after exercise.

Variant Allele A

- ▣ Quercetin
- ▣ Bromelain

INSIG2 rs7566605



INSIG2 rs7566605

- ❑ Normal Allele=G Variant Allele=C
- ❑ Insulin induced gene 2 produces a protein that alters lipid synthesis and stimulates fatty acid synthesis.
- ❑ Expression is down-regulated by insulin and resistance training in certain individuals.
- ❑ *Molecular Medicine 2018;17(1):1791-2997*
- ❑ *BMC Medical Genetics 2008; 9:117*

INSIG2 and Exercise

Normal Allele G

- ❑ Lower baseline subcutaneous fat.
- ❑ Both sexes better with higher weight - lower rep style weight training.
- ❑ Check ACE, ADRB2 and ACTN3

Variant Allele C

- ❑ Higher baseline subcutaneous fat
- ❑ Less weight loss with high weight low rep resistance training in women.
- ❑ Weight gain with high weight low rep resistance training in men.
- ❑ Better with endurance style weight training.

IL6 rs1800795



IL6 rs1800795

- ❑ Normal Allele =C Variant Allele=G
- ❑ Interleukin 6 is an inflammatory cytokine stimulated under several conditions such as injury, fever, exercise, stress and obesity.
- ❑ Increases neutrophils and B-cells, TNF-a and CRP.
 - ❑ *Vaxillaire M et al, Diabetes 2008 Jan;57(1):244-54*
 - ❑ *Gatti LL,et al, Arch Med Res 2007 Jul;35(5):551-5*
 - ❑ *Antonicelli R et al, Int J Cardiol 2005 Sep 1;103(3):266-71*

IL6 G Allele and Exercise.

- ❑ Increased IL6 production –double edged sword!.
- ❑ Increased tendonopathies and joint degradation with endurance.
- ❑ Better advantage with power sports.
- ❑ Increased risk of obesity and diabetes.

❑ *J Clin Endocrinol Metabol* 2004

❑ *J Sports Med Phys Fitness* 2013

Support for IL6

- ❑ Liposomal glutathione
- ❑ NAC
- ❑ Resveratrol
- ❑ Curcumin??
- ❑ Low inflammatory diet.
- ❑ Lower carbohydrate diet.

Case Studies

Genetics at PLAY!

Comparative Integration

❑ ACTN3 – C/T

❑ ACE – G/G

❑ ADBR2 – G/G

❑ INSIG2 – G/C

❑ IL-6 – G/G

❑ ACTN3 – C/T

❑ ACE – A/A

❑ ADBR2 – A/A

❑ INSIG2 – G/C

❑ IL6 – C/G

Case Study 1

- ❑ Michael is a 41-year-old runner. He has been racing half marathons for over decade.
- ❑ The past 5 years his times had increased significantly (7-10 minutes) and he felt more tired and inflamed.
- ❑ At the end of a long run or race he “felt like there was no fuel in his muscles” and would often get cramping at night.
- ❑ Gained 8 lbs. in the last year despite reducing carb and saturated fats in this diet.

Case Study 1 Genotype

- ❑ ACTN3 – C/T: mixed fast and slow twitch.
- ❑ ACE – G/G: increased blood flow in short bursts.
- ❑ ADBR2 – G/G: increased bronchodilation and vasoconstriction and adrenaline.
- ❑ INSIG2 – G/C: moderate resistance training.
- ❑ IL-6 – G/G – increased IL6 with endurance.

Case Study 1 Exercise Plan

- ❑ Slow integration over 1-month period to 90% HIIT style workouts.
- ❑ 1-hour interval training – 2 mins at 70% capacity with 1min recovery at 50%.
- ❑ 45 mins interval training – 1.5 mins at 80% capacity with 45 sec recovery at 40%.
- ❑ 35 mins interval training – 45 seconds at 85-88% capacity and 30 sec recovery at 30%.

Case Study 1 Supplement Plan

- ❑ Tryptic Decapeptide, L-theanine combo– 1 cap BID empty stomach.
- ❑ Liposomal glutathione – 1 cap BID empty stomach for 8 weeks then reduce to 1 per day.
- ❑ NAC – 1 cap BID empty stomach for 8 weeks and then reduce to 1 per day.
- ❑ Resveratrol– 1 cap BID for 4 weeks and then reduce to 1 per day.

Case Study 1 Outcome

- ❑ Within 10 days, he felt “less tired and less inflamed”.
- ❑ 1 month later he had lost 4 lbs., felt “stronger and lighter”.
- ❑ 3 months later he had lost 9 lbs., had no injuries and began racing 5 km.
- ❑ 1.5 years later he won his first 5 km race, maintained his weight loss and remained injury free.

Case Study 2

- ❑ Julie is a 53-year-old marathon runner, had been running long distance since high school.
- ❑ Got into a new relationship and began training HIIT style with him.
- ❑ Within 6 months she had gained more muscle size and strength but felt more tired and had strained her right gastroc and left hamstring and put on 5lbs.

Case Study 2 Genotype

- ❑ ACTN3 – C/T: mixed fibers.
- ❑ ACE – A/A: decreased blood perfusion and electrolyte control.
- ❑ ADBR2 – A/A: increased bronchoconstriction and vasodilation.
- ❑ INSIG2 – G/C : moderate resistance training.
- ❑ IL6 – C/G: lower IL6 with endurance.

Case Study Treatment Plan

- ❑ Returned Julie back to distance running- 28-35 km max 1 every 10 days.
- ❑ 3 days a week 15 km runs
- ❑ 1 day a week longer slower intervals.
- ❑ 2 days a week moderate weight training (12-14 reps) with medium weights.
- ❑ Potassium – 100 mg on days with food.

Case Study 2 Outcome

- ❑ Within 1-month Julie felt more energetic, hamstring was asymptomatic and 2 small flares of the gastroc.
- ❑ Within 2 months she had dropped 7 lbs., had no injuries and better than ever.
- ❑ 1 year later she had PB'd on 2 half marathon races.
- ❑ 2 years later she won her first masters half marathon.

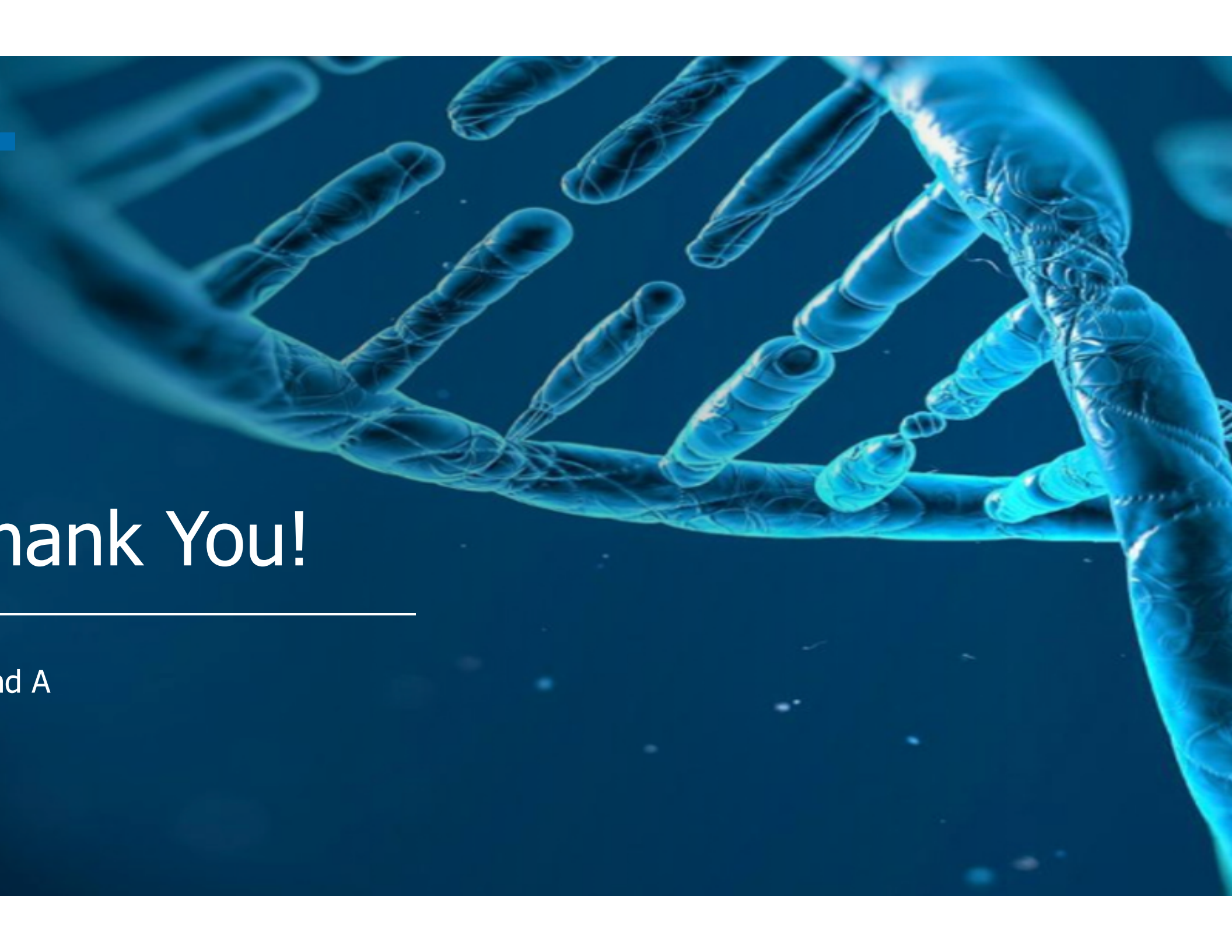
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Thank You!

and A