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THERAPEUTICS

Corporate Presentation

December 2018

Forward-Looking Statements

This presentation contains statements about our future expectations, plans and prospects that constitute forward-looking statements for purposes of the safe harbor provisions of the Private Securities Litigation Reform Act of 1995. Actual results may differ materially from those indicated by these forward-looking statements as a result of various important factors, including risks relating to: both our and our collaborators' ability to successfully research, obtain regulatory approvals for, develop and commercialize products based upon our technologies; our ability to obtain and maintain proprietary protection for our technologies and product candidates; our reliance on third parties to manufacture our preclinical and clinical drug supplies; competitive pressures; our ability to obtain and maintain strategic collaborations; compliance with our in-license agreements; our ability to successfully execute on, and receive favorable results from, our proprietary drug development efforts; market acceptance of our drug candidates; retaining members of our senior management; and our ability to raise additional funds to finance our operations.

The forward-looking statements included in this presentation represent our views as of the date of this presentation. We anticipate that subsequent events and developments will cause our views to change. While we may elect to update these forward-looking statements in the future, we specifically disclaim any obligation to do so. These forward-looking statements should not be relied upon as representing our views as of any date subsequent to the date of this presentation.

For more information regarding risks and uncertainties that could affect the results of our operations or financial condition review our filings with the Securities and Exchange Commission (in particular, our most recent Annual Report on Form 10-K and any subsequently filed Quarterly Reports on Form 10-Q).

Corporate Overview

Focused on best-in-class drugs for metabolic and endocrine diseases

- Two Phase 2 programs supported by positive clinical data

Metabolic Disease Program: VK2809 for NASH

- Novel, selective thyroid receptor-β (TRβ) agonist
- Phase 2 results demonstrate significant reduction in liver fat content, lipids

Rare Disease Program: VK0214 for X-ALD

- Potential IND, PoC study to begin 2019

Musculoskeletal Program: VK5211 for hip fracture recovery

- Non-steroidal selective androgen receptor modulator (SARM)
- Phase 2 results demonstrate significant increases in lean body mass

Pipeline Highlights

Product Candidates	Indication	Development Stage				Status
Development Programs		Preclin	Phase 1	Phase 2	Phase 3	
VK2809 (TRβ agonist)	*NASH*					Initiate next clinical study, 2019
VK0214 (TRβ agonist)	*X-ALD*					IND planned, 2019
Other Programs		Preclin	Phase 1	Phase 2	Phase 3	
VK5211 (SARM)	*Hip fracture, muscle wasting*					Phase 2 completed
VK0612 (FBPase inhibitor)	*Type 2 Diabetes*					Phase 2 ready
VK1430 (DGAT-1 inhibitor)	*Hypertriglyceridemia, NASH*					Preclinical

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Metabolic Disease Program

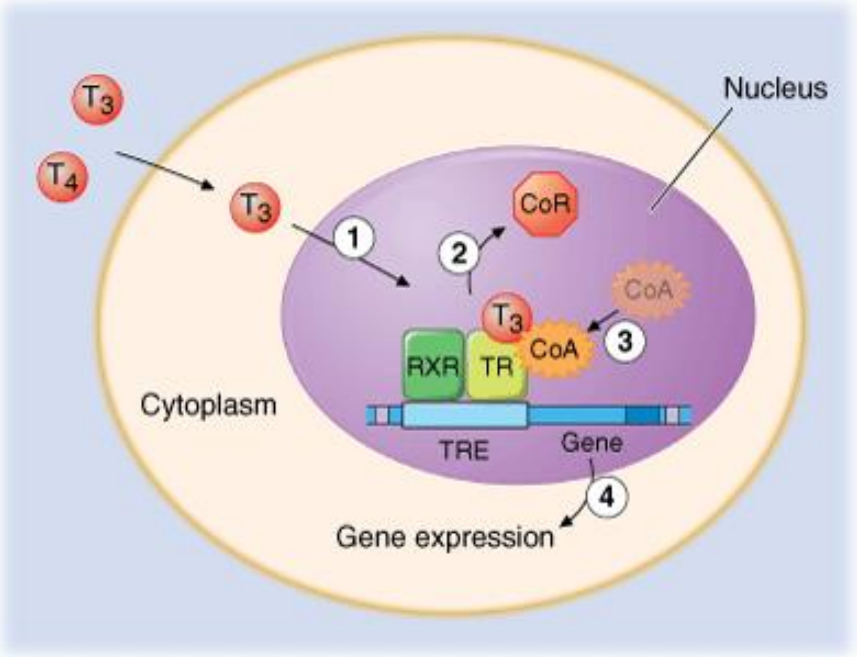
VK2809: Selective Thyroid Receptor-β Agonist

Liver Disorders

Metabolic Disease Program: Selective Thyroid-β Agonists

- **Proprietary platform for small molecule thyroid hormone mimetics**
  - Highly tissue and receptor selective
  - Produce potent lipid reductions in animals and humans
  - Unique chemical scaffolds, expected wider safety window vs. other approaches
- **Biological profiles suggest potential benefit in multiple indications**
  - Broad: NASH, hypercholesterolemia, dyslipidemia
  - Rare: X-linked adrenoleukodystrophy (X-ALD), other
- **Lead molecules VK2809, VK0214**
  - Oral, once-daily formulations
  - VK2809: Recently-completed Phase 2 trial in NAFLD and hypercholesterolemia
  - VK0214: Preclinical, X-ALD

Thyroid Receptor Overview



Key steps in receptor activation: Endogenous thyroid hormone T3 crosses mitochondrial membrane (1) binding thyroid receptor TR, dissociating co-repressor CoR (2). Subsequent binding of co-activator CoA (3) results in altered gene expression (4). RXR: retinoid X receptor; TRE: thyroid response element.

- **Nuclear hormone receptors**
- **Two major subtypes**
  - **Thyroid beta receptor:** Liver, brain; modulates cholesterol, triglyceride levels
  - **Thyroid alpha receptor:** Cardiac tissue, modulates heart rate, contraction

Therapeutic goal, lipid setting: β-receptor selectivity; minimize alpha-effects

Graphic: *Harrison's Principles of Internal Medicine,* 17th Edition, Chapter 335, Fig 335-4, copyright McGraw-Hill, 2008.

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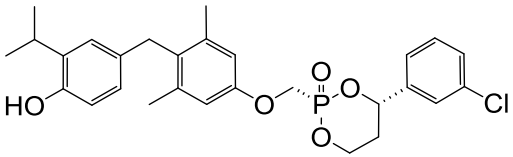
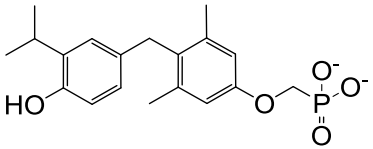
VK2809: Unique Liver-Targeted Characteristics



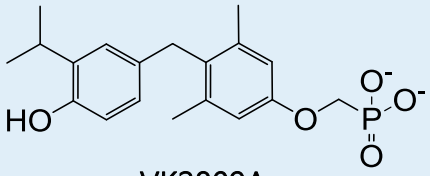
VK2809, Novel Prodrug

Following oral dosing:

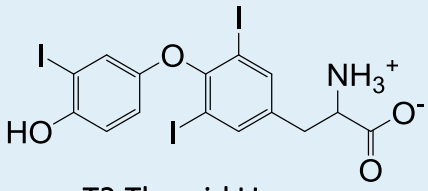
- Cyp3A4-mediated cleavage of prodrug
- 3A4 primarily expressed in liver
- Results in targeted delivery of drug to liver



VK2809A, Potent TRβ Agonist, 2.2 nM Ki



VK2809A



T3 Thyroid Hormone

- 17:1 selective for β:α
- Highly negatively charged
  - Poor passive diffusion
- Not actively transported
  - Due to altered chemistry
- Targeted hepatic re-uptake
  - Selective liver re-absorption via hepatic OATP1B3 transporter

- 1:2 selective for β:α
- Effectively neutral charge
- Active uptake in multiple tissues via MCT8
- Broad systemic availability
- Impractical for development due to safety

Selective activation, differentiated chemistry lends VK2809 liver selectivity; potentially minimizes risk of systemic effects

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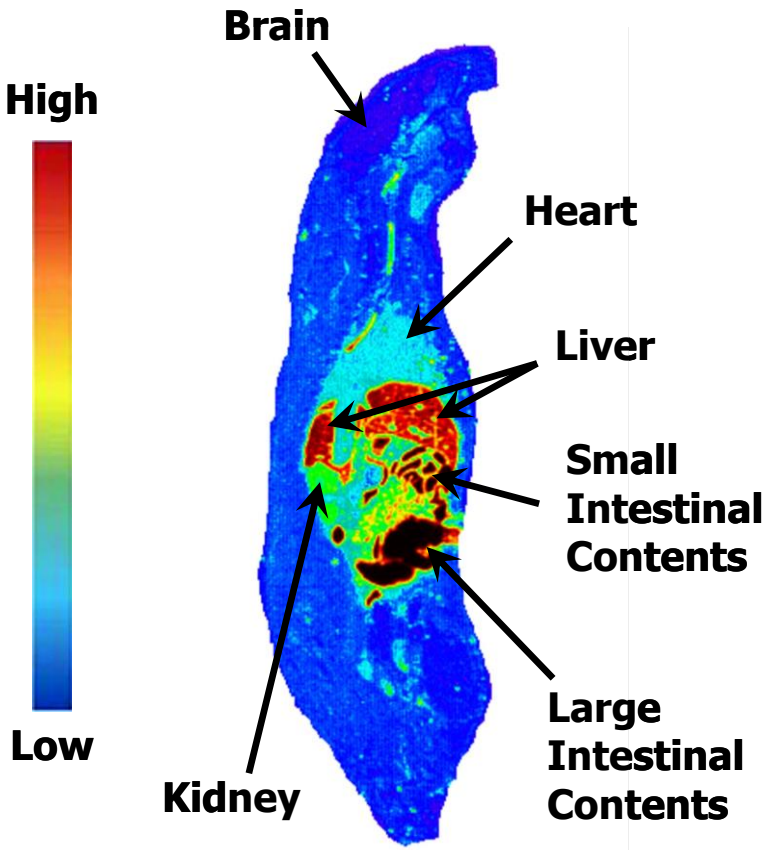
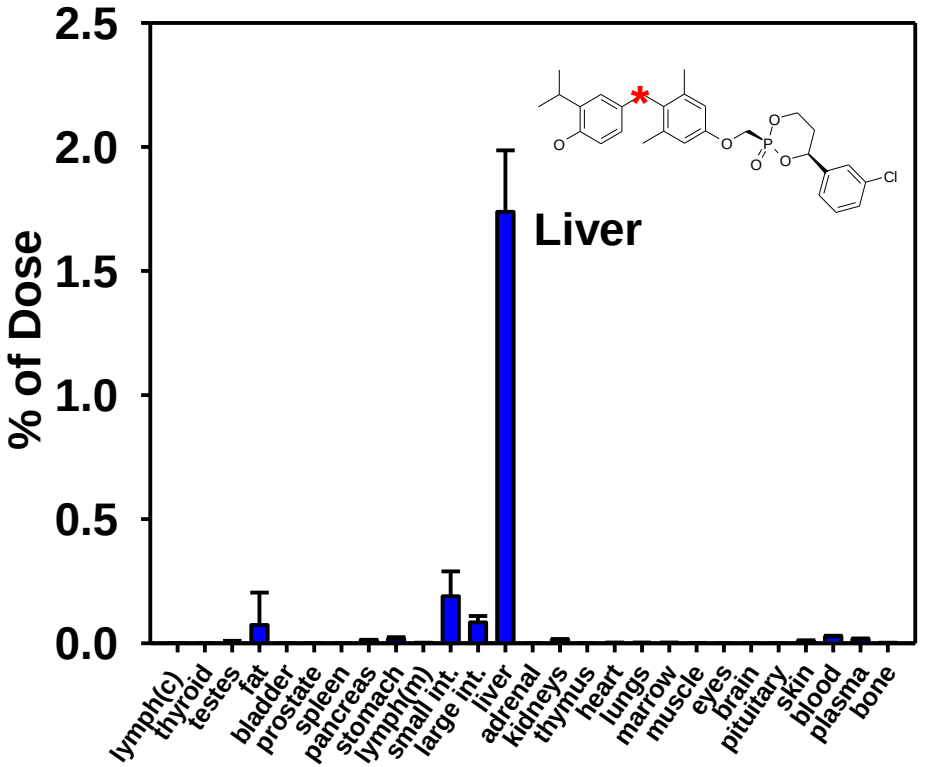
VK2809: Evidence of Liver Selectivity

^{14}C QWBA (4 h)



^{14}C Tissue Distribution (24 h)

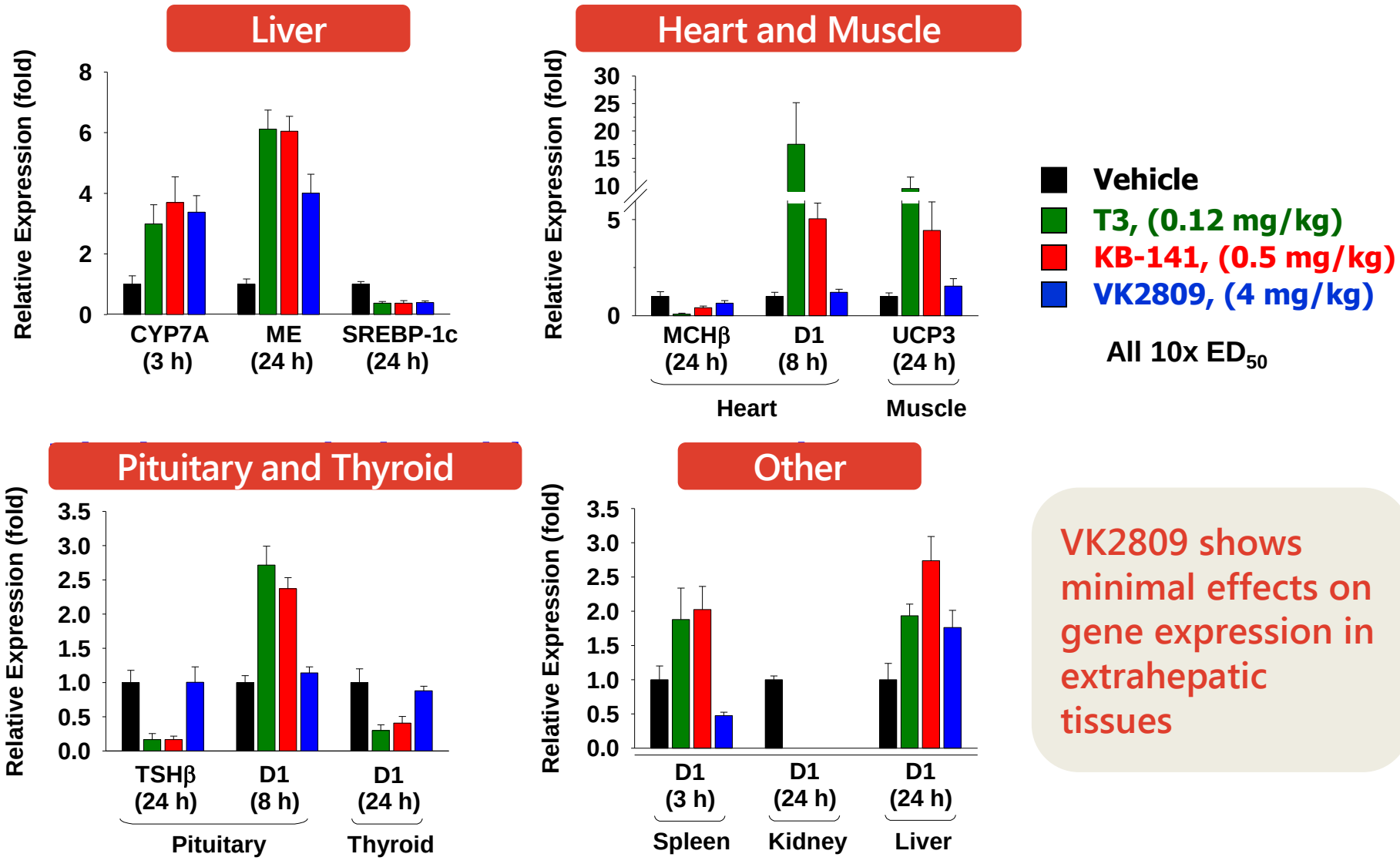


SD rat, 5mg/kg dose; approx. 30x anticipated human doses

Liver selectivity confirmed via radiologic analysis

1) *Drug Metab. Disp.*, 36(11), 2393-2403, (2008).

VK2809: Liver-Selective Transcriptional Effects



VK2809 shows minimal effects on gene expression in extrahepatic tissues

1) *Proc. Nat. Acad. Sci.*, 104(39), 15490-15495, (2007).

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Thyroid Receptor β Agonists for NAFLD and NASH

Development of NASH:

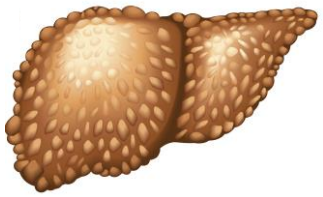
Healthy liver

Accumulation of fatty acids, triglycerides

Oxidative stress, inflammatory response

NASH: Steatosis, ballooning, hepatocyte damage

NAFLD Progression



- Cirrhosis
- HCC
- Liver failure

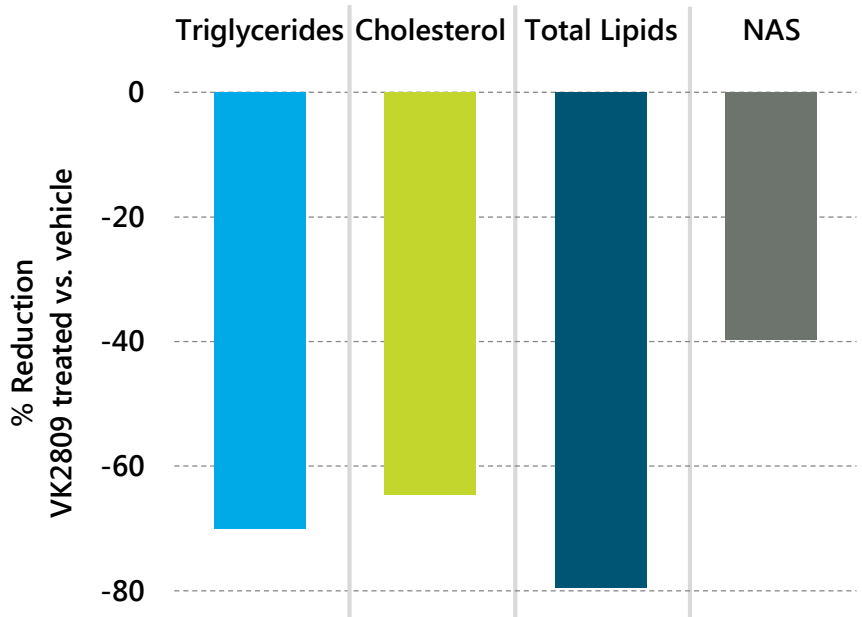
- β-Receptor: Key role in lipid metabolism; systemic and liver-specific effects
- Receptor localized to liver, limited ex-hepatic expression
- In vivo evidence suggests β-activation provides anti-fibrotic benefits
- Clinical data indicate a correlation between reduced liver fat, improvement in NAS

An agent that reduces liver fat, improves systemic lipids, and antagonizes fibrotic signaling could provide multi-pronged benefits in NASH

VK2809 Significantly Reduces Steatosis in Diet-Induced NASH

- Evaluation in biopsy-confirmed diet-induced NASH model
  - Rodent model designed to reflect progression of disease in humans
  - Animals biopsied pre-study; only those with NASH *and* fibrosis selected
  - VK2809 dosed once-daily for 8 weeks

Change in Liver Lipids Following 8 Weeks Dosing With VK2809



	Triglycerides	Cholesterol	Total Lipids	NAS
% Difference:	-70.0%	-64.6%	-79.5%	-39.7%
p-value:	<0.0001	<0.0001	<0.0001	<0.0001

Treatment with VK2809 significantly improves lipids, steatosis, NAS at 8 weeks; well-tolerated with no evidence of toxicity

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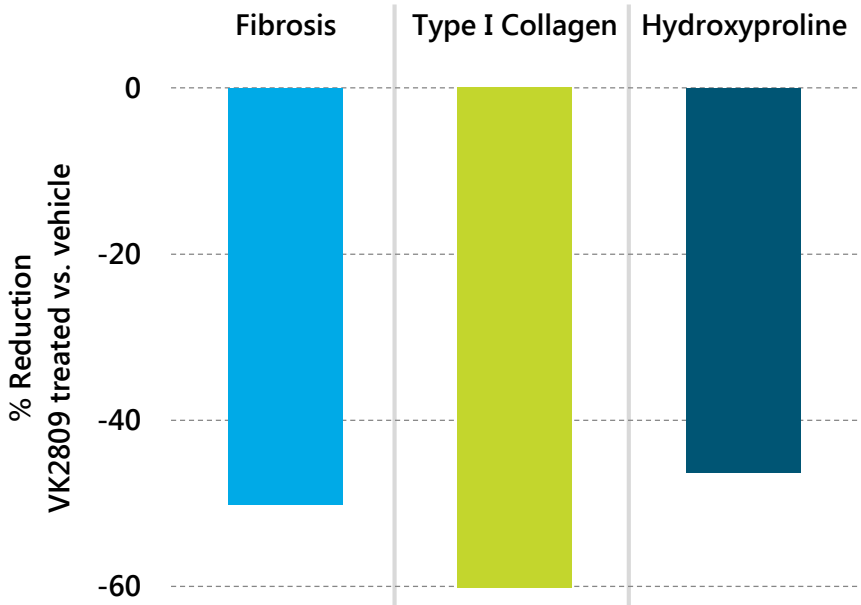
VK2809 Improves Fibrosis in Diet-Induced NASH Model

- Significant reductions in fibrosis, collagen, hydroxyproline after 8 weeks
- Supports thesis that selective TRβ activation produces broad metabolic benefits
- Gene expression data show improvements in genes related to lipid metabolism, insulin sensitivity, fibrogenic signaling

Change in Liver Fibrosis Following 8 Weeks Dosing With VK2809



	Fibrosis	Type I Collagen	Hydroxyproline
% Difference:	-50.2%	-60.2%	-46.3%
p-value:	<0.01	<0.005	0.01

VK2809 significantly improved NASH and fibrosis in this model

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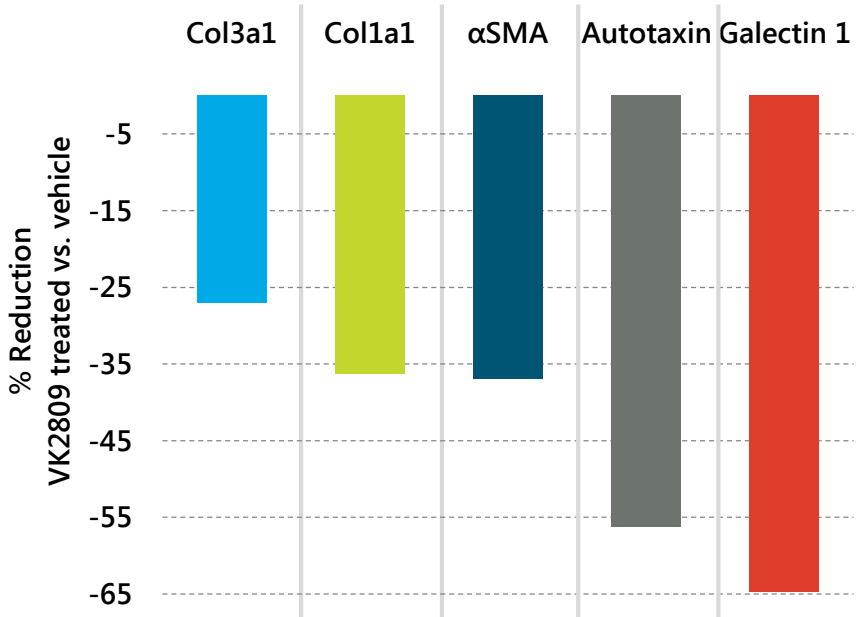
VK2809: Representative Gene Effects, DIO NASH Model

- VK2809 reduces expression and signaling of key fibrosis drivers
- Improvement in genes associated with lipid metabolism, insulin sensitivity also observed
- Overall gene expression changes align with observed improved histology

Change Pro-Fibrogenic Gene Expression Following VK2809 Treatment



	Col3a1	Col1a1	αSMA	Autotaxin	Galectin 1
% Difference	-36.3%	-27.1%	-37.0%	-56.3%	-64.7%
p-value	0.07	<0.05	<0.05	<0.001	<0.001

TRβ mechanism provides broad histologic benefits; effects span steatosis, inflammation, fibrosis.

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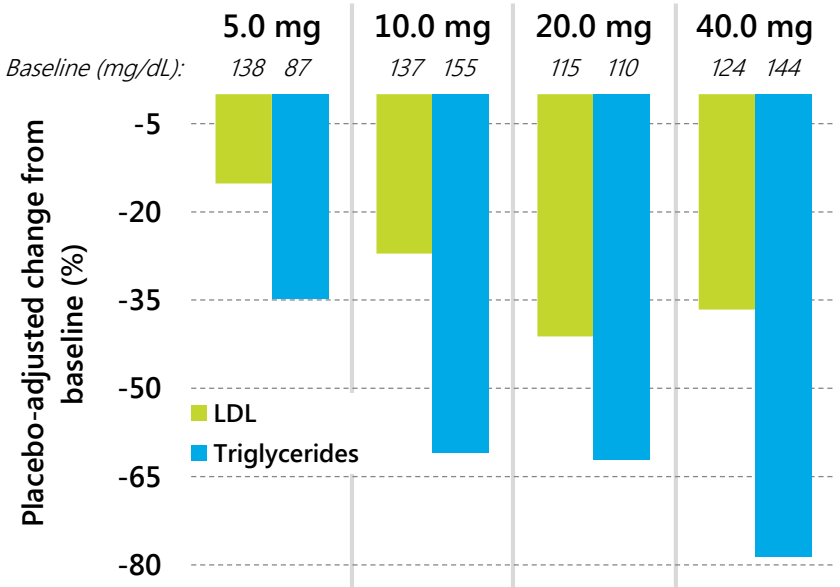
VK2809 Clinical Highlights: 14-Day Phase 1b Study

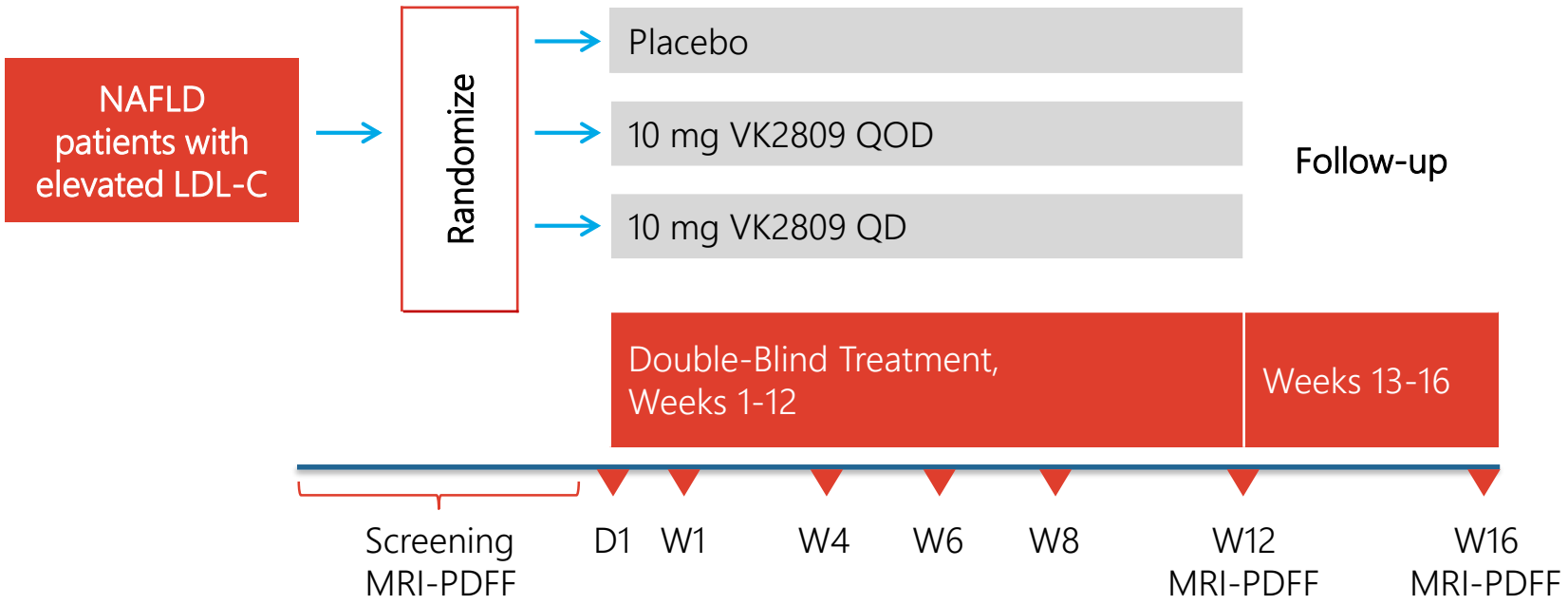
- Placebo-controlled trial (n=56), mild hypercholesterolemia
  - Enrollment criterion: LDL ≥ 100 mg/dL
- Results: clinically, statistically significant reductions in LDL
- Up to 79% reduction in triglycerides
  - Major component of liver fat
- Encouraging safety and tolerability, no SAEs

Placebo-Adjusted Change From Baseline (%)



	5.0 mg	10.0 mg	20.0 mg	40.0 mg
Placebo-adjusted reduction, LDL:	-15.2% p=0.026	-27.1% p=0.0003	-41.2% p<0.0001	-36.6% p<0.0001
Placebo-adjusted reduction, triglycerides:	-34.8% p=0.052	-61.0% p=0.0019	-62.1% p=0.0007	-78.6% p=0.0001

VK2809-201: Phase 2 Study Design

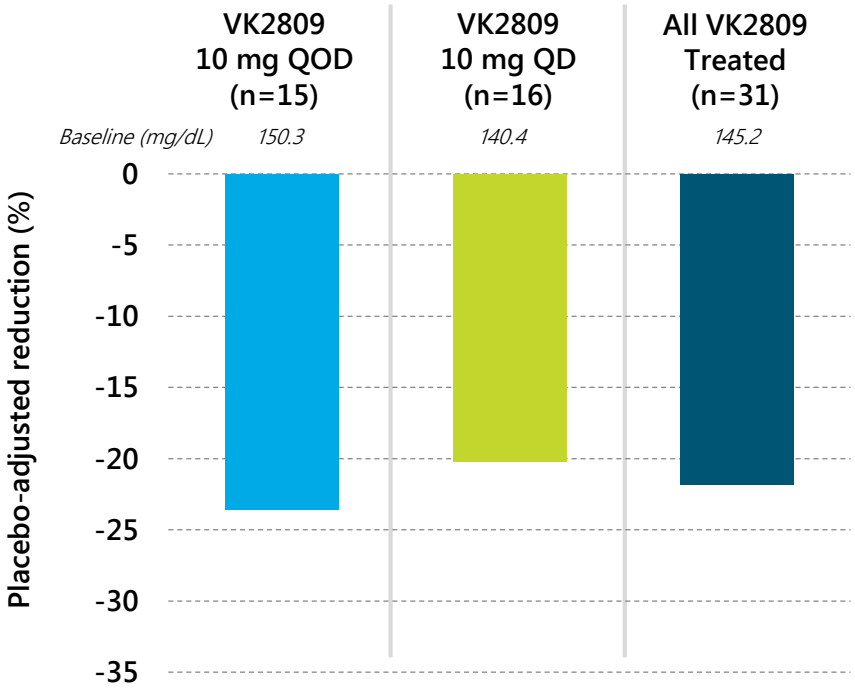


- Multi-arm, dose-ranging, 12 week Phase 2 trial
  - Target enrollment: 20 patients per arm
  - **Primary endpoint:** Change in LDL-C vs. placebo
  - **Secondary endpoint:** Change in liver fat by MRI-PDFF
  - **Exploratory endpoints:** Changes in atherogenic proteins

VK2809 Significantly Reduced LDL-C After 12 Weeks

- Significant Reductions from Baseline in LDL-C
  - Placebo mean change: 0.53 mg/dL
  - 10 mg QOD change: -32.3 mg/dL
  - 10 mg QD change: -25.2 mg/dL
  - All treated arms significant vs baseline and placebo

Placebo-Adjusted % Change in LDL-C at Week 12

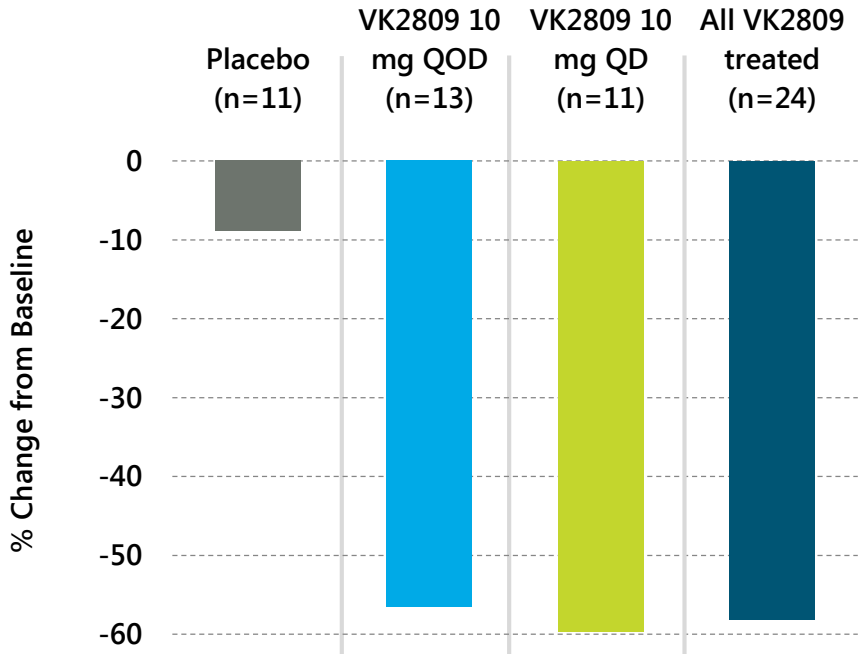


% Change	-23.6%	-20.2%	-21.8%
p-value	0.0121	0.0269	0.0061

VK2809 Produced Significant Relative Reductions in Liver Fat

- Significant Relative Reductions from Baseline in Liver Fat by MRI-PDFF
- Patients receiving VK2809 experienced relative reductions of up to 72% (10 mg QOD) to 76% (10 mg QD) at Week 12

Median Relative % Change in Liver Fat at 12 Weeks

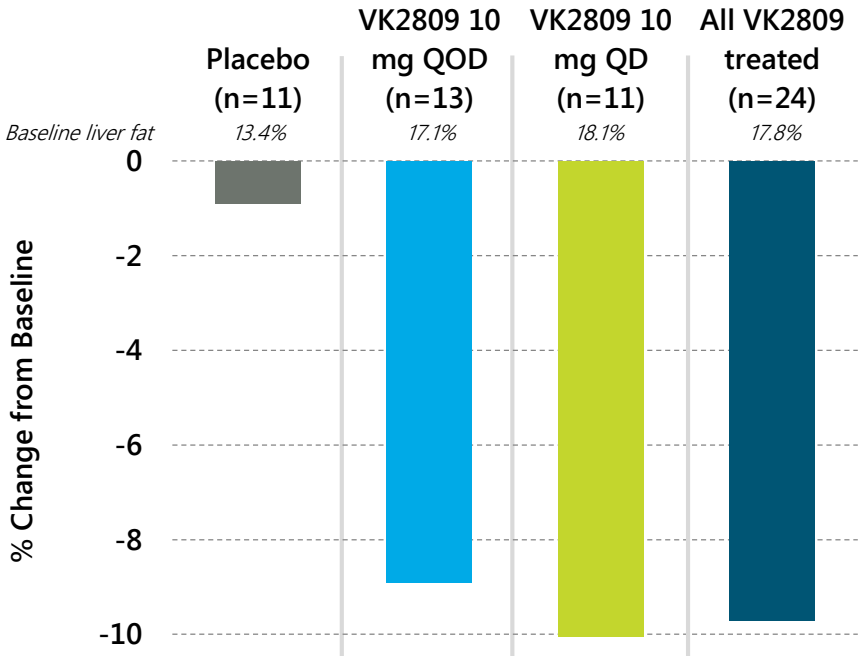


	Placebo (n=11)	VK2809 10 mg QOD (n=13)	VK2809 10 mg QD (n=11)	All VK2809 treated (n=24)
% Change	-8.9%	-56.5%	-59.7%	-58.1%
p-value vs. placebo	-	0.0014	0.0003	0.0002

VK2809 Produced Significant Absolute Reductions in Liver Fat

- Significant Absolute Reductions from Baseline in Liver Fat by MRI-PDFF

Mean Absolute % Change in Liver Fat at 12 Weeks



	Placebo (n=11)	VK2809 10 mg QOD (n=13)	VK2809 10 mg QD (n=11)	All VK2809 treated (n=24)
% Change (SD)	-0.9% (2.8)	-8.9% (6.2)	-10.6% (5.2)	-9.7% (5.7)
p-value vs. placebo	-	0.011	0.0025	0.0019

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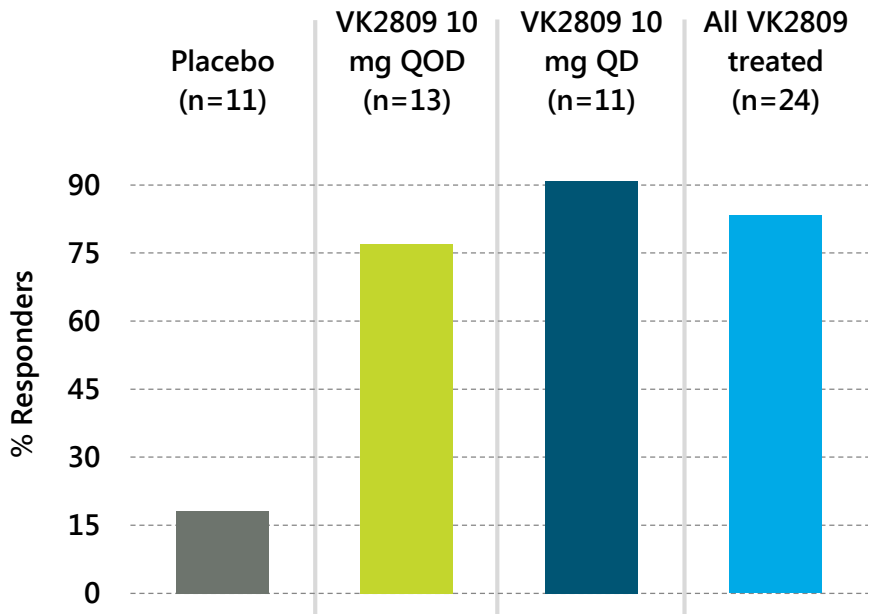
VK2809 Cohorts Demonstrated Response Rates of up to 91%

- Up to 91% of VK2809 patients experienced response, as defined by ≥30% decrease in liver fat
- Two-thirds of VK2809 patients demonstrated liver fat reductions exceeding 50%
- Reduction in liver fat correlated with improved long-term histology

Patients with ≥30 % Reduction in Liver Fat at 12 Weeks



Responders	18.2%	76.9%	90.9%	83.3%
p-value vs. placebo	-	0.012	0.0019	0.0011

1) *Ther. Adv. Gastroenterol.*, 9(5), 692-701, (2016).

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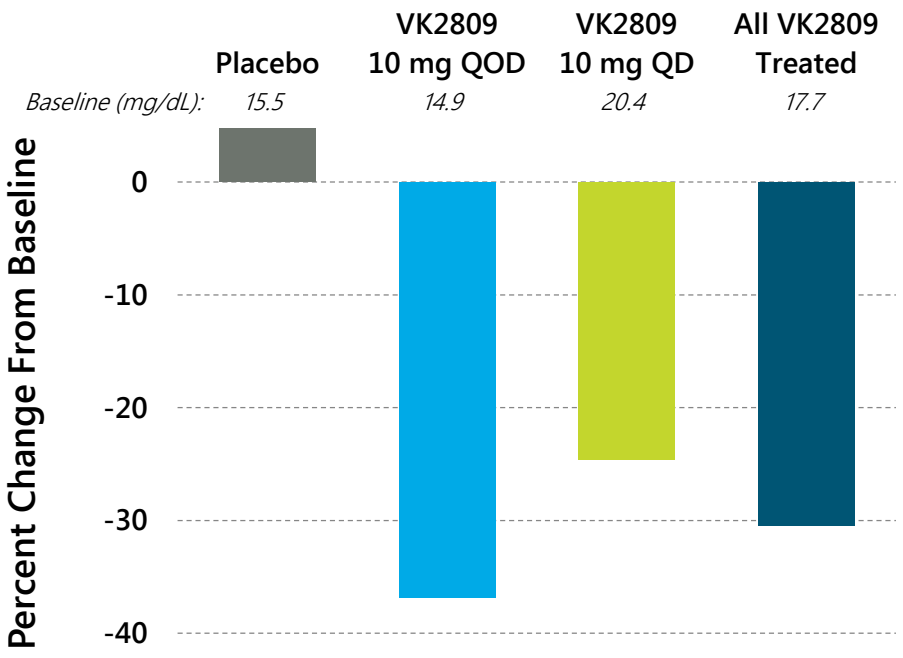
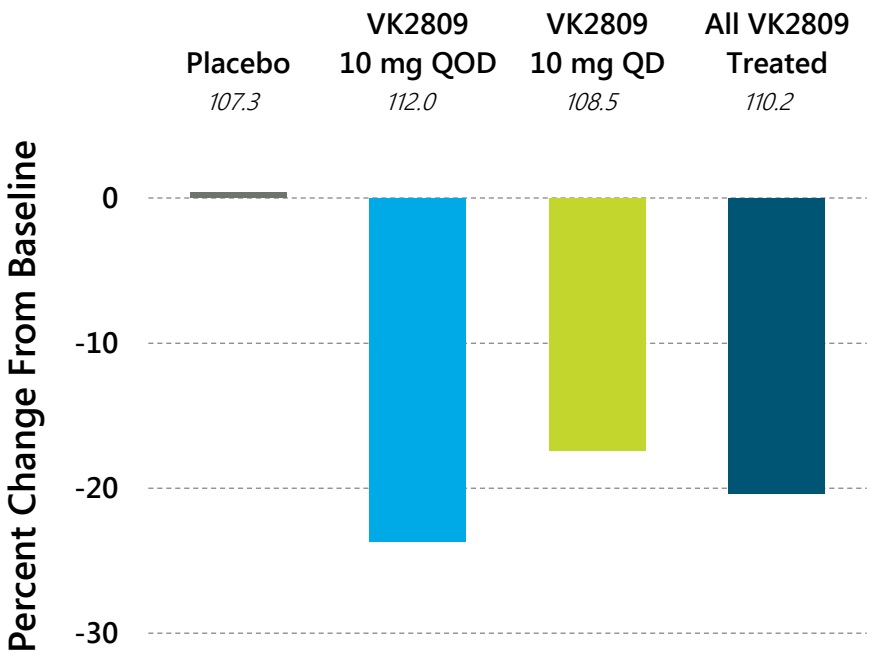
VK2809 Improved Atherogenic Protein Levels at 12 Weeks

Change in Lipoprotein(a) at Week 12



Change in Apolipoprotein B at Week 12



Change	4.7%	-36.8%	-24.6%	-30.4%	0.4%	-23.7%	-17.4%	-20.4%
p-value	-	0.097	0.049	0.039	-	0.0021	0.020	0.0021

- Significant reduction in Lp(a) ApoB achieved at 12 Weeks
- Suggests potential cardiovascular benefits

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VK2809-201: Summary of Adverse Events

	Placebo	VK2809 10 mg QOD	VK2809 10 mg QD
Randomized (n)	15	16	16
Number of Reported AEs	36	21	31
Number (%) of subjects with at least one reported:			
Treatment emergent AE (TEAE)	9 (60)	11 (69)	10 (62)
Serious TEAEs	0 (0)	0 (0)	0 (0)
Drug-related serious TEAE	0 (0)	0 (0)	0 (0)

- Encouraging safety and tolerability
- No serious adverse events observed in any arm
- No dose-related trends in AEs
- Excellent GI tolerability

VK2809-201: Safety Summary

- Mean ALT, AST levels in VK2809-treated subjects were reduced relative to placebo at Week 12
  - Patients with elevated baseline ALT demonstrated greater improvement relative to placebo at Weeks 12 and 16
  - Differences grew larger at Week 16, suggesting continued improvement in liver health
- No other liver function tests were significantly different from placebo at Week 12
- No changes to thyroid hormone axis were observed in VK2809-treated cohorts vs. placebo
- No changes to cardiovascular safety markers troponin or NT proBNP were observed in VK2809-treated cohorts vs. placebo
- No changes to weight, pulse, or blood pressure were observed in VK2809-treated patients vs. placebo

VK2809-201: Summary and Conclusions

- VK2809 produced robust reduction in liver fat on MRI-PDFF in NAFLD patients after 12 weeks of oral dosing
- Up to 91% of patients dosed with VK2809 experienced a response as demonstrated by liver fat reductions ≥30% relative to baseline; 67% experienced liver fat reductions ≥50%
- VK2809 produced significant reduction in LDL-C, Apo B, and Lp(a) relative to placebo in NAFLD patients, suggesting long term CV benefit
- No changes to HDL were observed among treated vs. placebo patients
- VK2809 was safe in this 12 week Phase 2 study
- VK2809 was well-tolerated in this 12 week Phase 2 study
  - Diarrhea, nausea higher in placebo (n=3 vs. n=2 for combined VK2809 cohorts)

VK2809-201: Safety, Tolerability, Next Steps

- Next steps
  - Submit IND to GI division 2019
  - Initiate clinical study in biopsy-confirmed NASH

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Rare Disease Program

VK0214

X-Linked Adrenoleukodystrophy

VK0214 for X-ALD

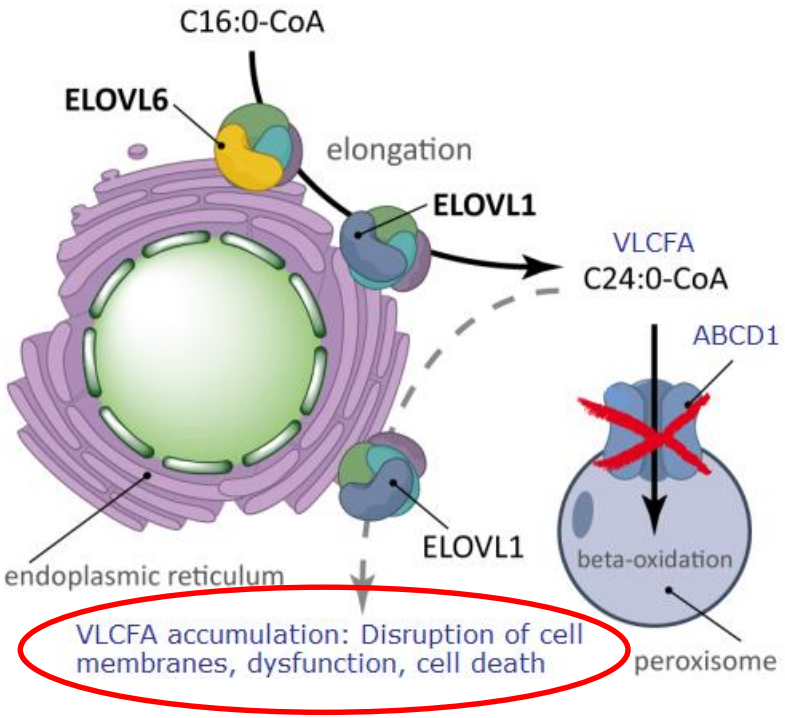
- X-Linked adrenoleukodystrophy (X-ALD)
  - Orphan neurodegenerative disorder
  - X-linked: Carried by females, primarily manifesting in males
  - No cure, no approved therapy
- Most severe form: Cerebral ALD
  - Rapidly progressive inflammatory demyelination; disruption of BBB
  - Affects ~35% before age 12 (CCALD), ~20% between age 20 – 35 (CALD)
  - Deterioration in speech, cognition; vegetative state within 3-5 years
- Most common form: Adrenomyeloneuropathy (AMN)
  - Affects spinal cord, motor neurons; no inflammatory component or brain involvement
  - Affects nearly all adult patients; considered "default" manifestation of ALD
  - Progressive motor impairment; wheelchair confinement, leg paralysis common

(1) *Biochimie*, **98** (2014) 135-142. (2) *Ann. Neurol.* **49**:512-517 (2001). (3) *Biochim. Biophys. Acta* **1822** (2012) 1465-1474. (4) *Orphanet J. Rare Dis.* **7**:51 (2012). (5) *Brain Pathol.* **20**(4): 845-856 (2010).

TRβ: X-Linked Adrenoleukodystrophy

Caused by mutation in gene for the ATP-Binding Cassette transporter D1 (ABCD1)

- Peroxisomal transporter of very long chain fatty acids (VLCFA)



ABCD1: Normal function to transport VLCFA into peroxisome for degradation

X-ALD: Defective ABCD1 leads to accumulation of VLCFA in tissues

High VLCFA levels disrupt cell membranes; inflammatory demyelination in brain tissue; motor neuron deterioration

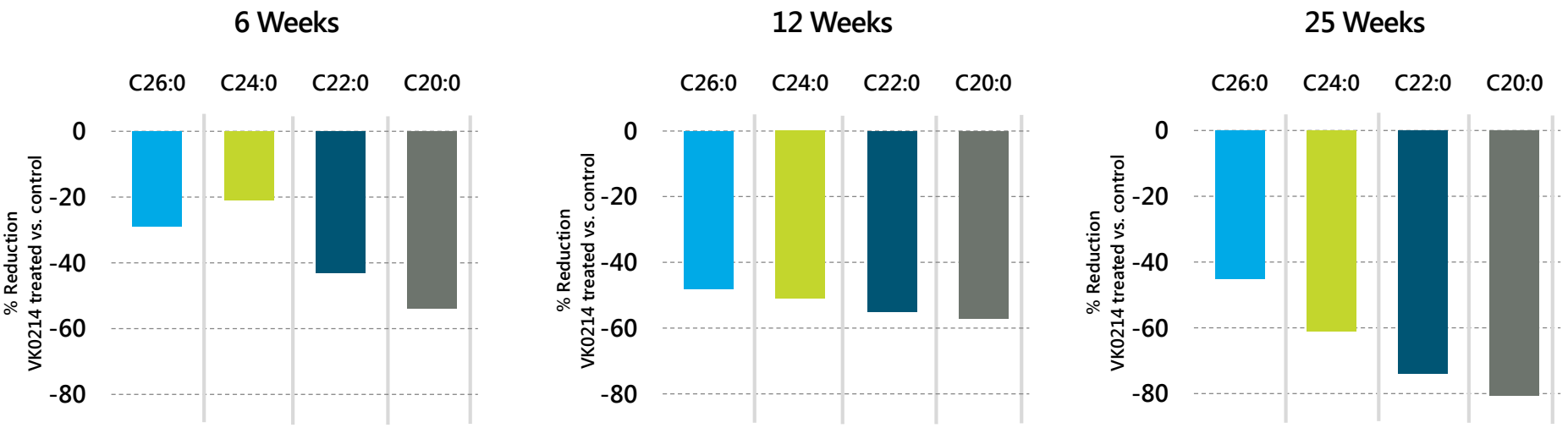
TRβ Agonists: Stimulate expression of compensatory transporters ABCD2, 3; may mitigate VLCFA elevation

Graphic adapted from http://www.x-ald.nl/origin-and-metabolism-of-vlcfa/.

VK0214: *In Vivo* Proof-of-Concept Data, ABCD1 KO Mouse

- ABCD1 Knockout model: Mimics biochemical features of human X-ALD
- VK0214: Durable and progressive reductions in plasma VLCFAs
  - Tissue effects suggest encouraging CNS activity following long-term exposure

Reductions in Plasma VLCFA-LPC, ABCD1 Knockout Model

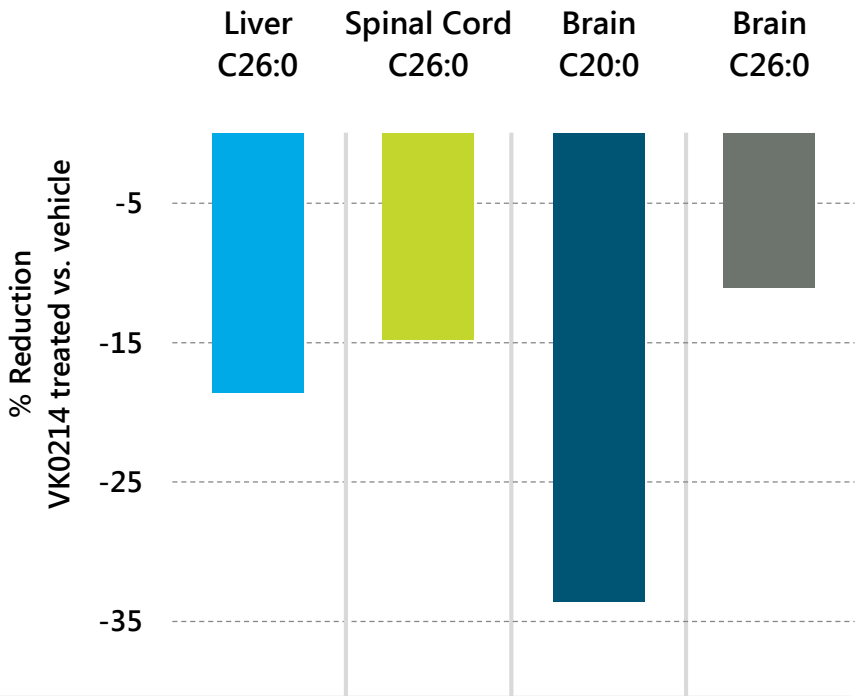


	C26:0	C24:0	C22:0	C20:0
% Chg:	-29%	-21%	-43%	-54%
p-value:	<0.0001	<0.005	<0.0001	<0.0001
% Chg:	-48%	-51%	-55%	-57%
p-value:	<0.0001	<0.0001	<0.0001	<0.0001
% Chg:	-45%	-61%	-74%	-82%
p-value:	<0.0001	<0.0001	<0.0001	<0.0001

VK0214: Reduces VLCFA Levels in Key Tissues

- Significant VLCFA reductions observed in multiple tissues
- Encouraging evidence of CNS activity
- Reductions in multiple VLCFAs consistent with plasma observations
- Suggests potential benefit in both cerebral and AMN forms of X-ALD
- Next steps: IND-filing, PoC study planned 2019

Change in Tissue VLCFAs: CNS and Peripheral Tissue



	Liver C26:0	Spinal Cord C26:0	Brain C20:0	Brain C26:0
% Difference:	-19%	-15%	-34%	-11%
p-value:	<0.05	<0.01	<0.0001	0.07

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Musculoskeletal Program

VK5211: Selective Androgen Receptor Modulator

Hip Fracture

Musculoskeletal Program: VK5211 for Hip Fracture

- **Novel Selective Androgen Receptor Modulator (SARM), for hip fracture**
  - VK5211 is a potentially best-in-class small molecule SARM
- **Promising efficacy signals to date**
  - Significant improvements in lean body mass in animals and humans
- **Target indication: Rehabilitation post-hip fracture**
  - Population rapidly loses muscle, bone, function
  - >300,000 patients per year, U.S.; expect continued growth
  - Market opportunity potentially exceeds $1B annually
- **Potential benefits in other fractures, joint replacements, and muscle wasting disorders**

VK5211: Potential Therapeutic Benefits of SARMs

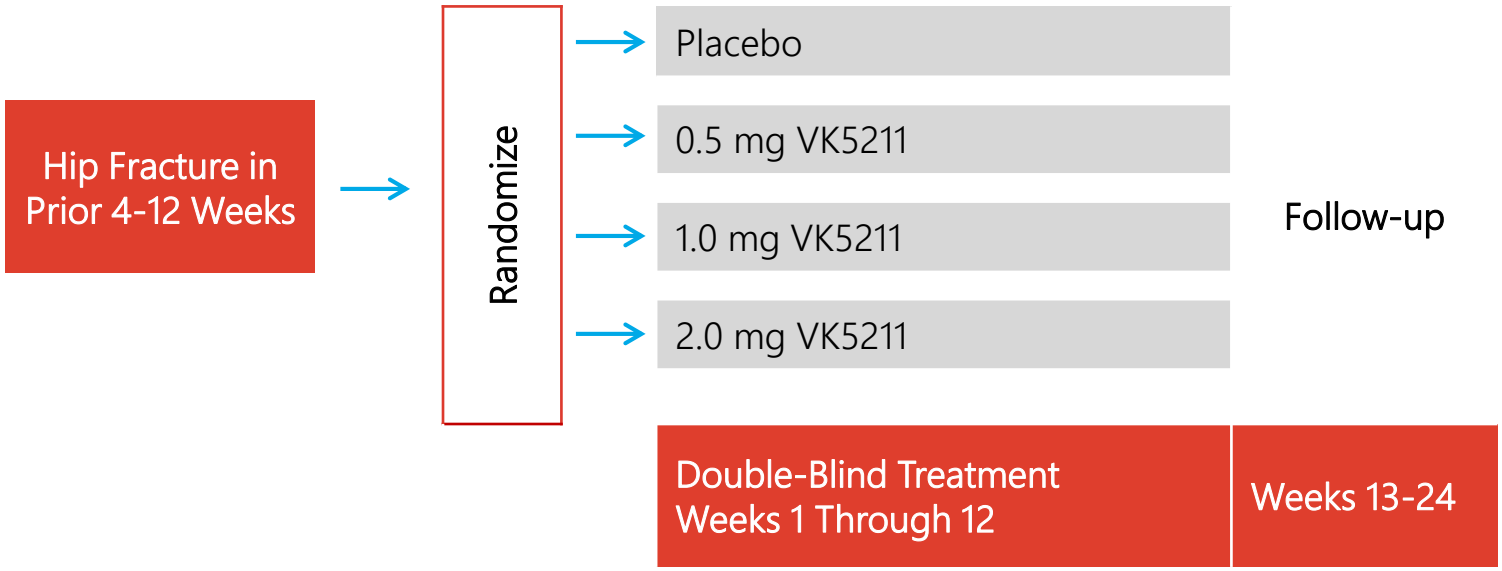
- ↑ Muscle Mass
- ↑ Muscle Strength

- ↑ Bone Formation
- ↑ Bone Strength
- ↓ Bone Resorption

- ↑ Cognition
- ↑ Libido
- ↑ Energy

Goal: Retain beneficial properties of natural androgens with fewer side effects relative to anabolic steroids

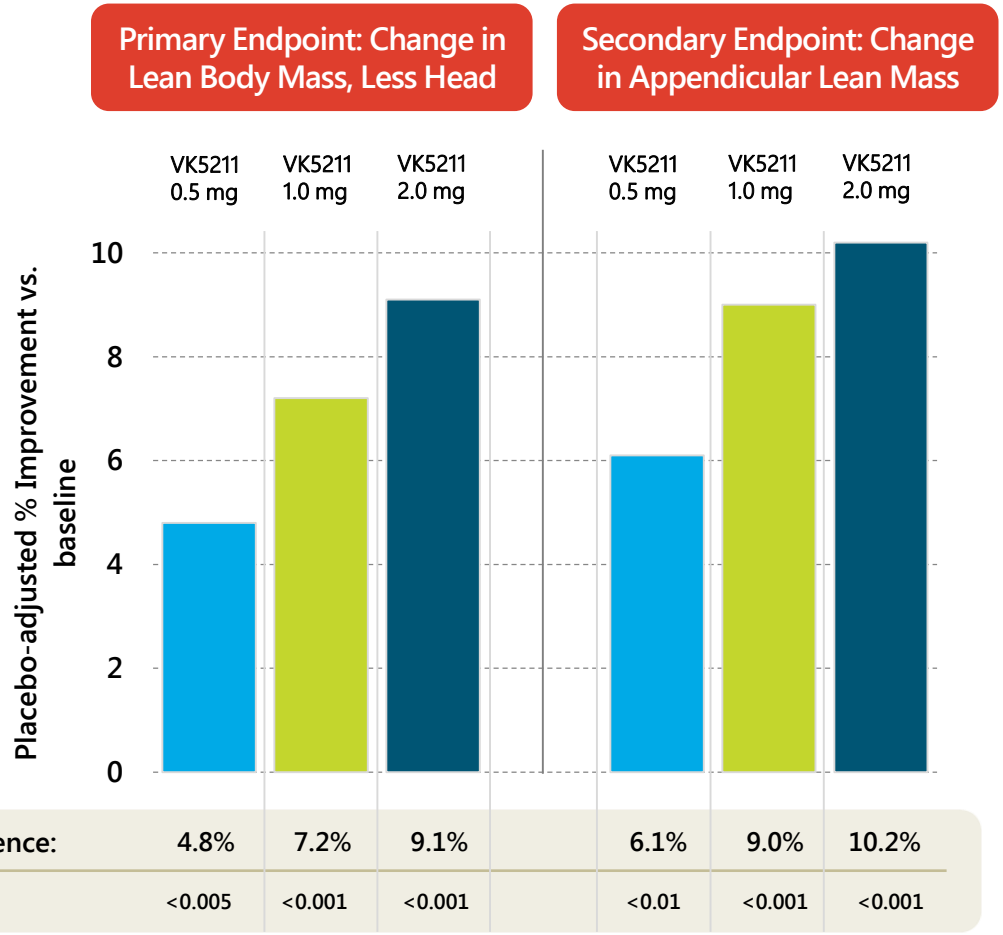
VK5211: Phase 2 Trial, Hip Fracture



- **12-week Phase 2 trial in 108 patients**
  - Once-daily oral dosing
  - Primary endpoint: Change in lean body mass
  - Secondary and exploratory endpoints: Change in appendicular lean mass, total lean body mass, BMD, functional status, ADL, QOL

Phase 2 Results Show Significant Increases in Lean Body Mass

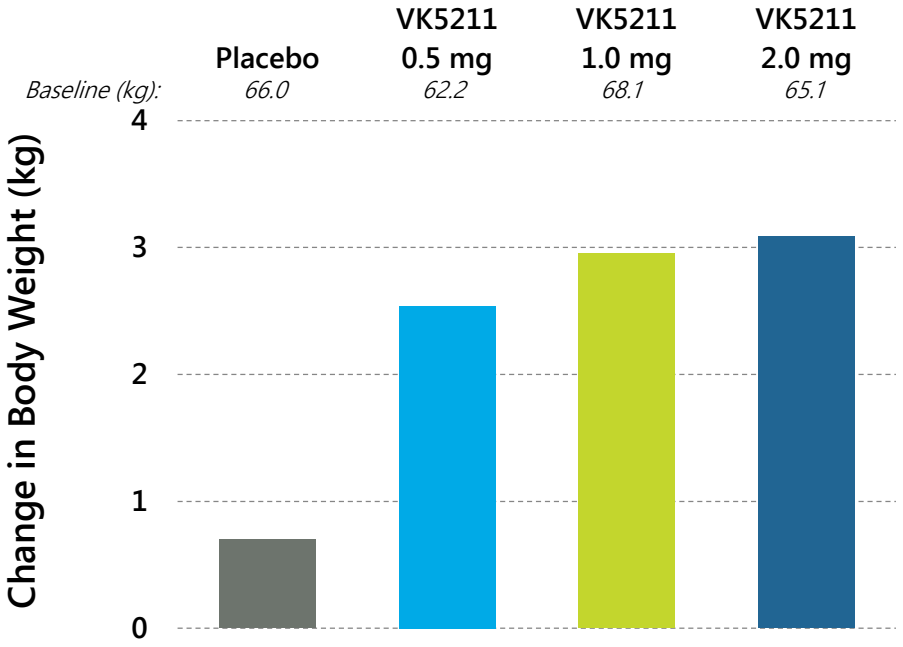
- Significant increases in LBM and appendicular lean mass following 12 weeks of daily dosing
- Consistent dose response observed across primary, secondary efficacy measures
- Encouraging safety and tolerability, no drug-related SAEs



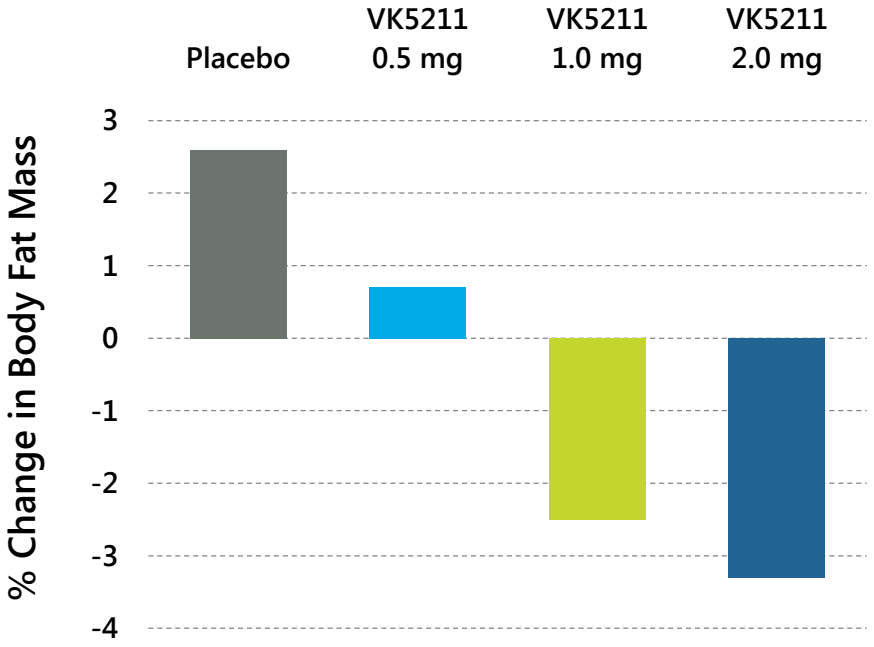
VK5211 produced robust dose-dependent effects on primary and all secondary measures of lean body mass

VK5211-201: Change in Body Composition at 12 Weeks

Change in Mean Body Weight, at Week 12



Change in Mean Fat Mass, at Week 12



Change	0.70 kg	2.54 kg	2.95 kg	3.09 kg	2.9%	0.7%	-2.5%	-3.3%
p-value	-	NS	NS	NS	-	0.24	0.11	0.01

- Dose-dependent increase in mean body weight
- Dose-dependent decrease in mean fat mass; significant at high dose

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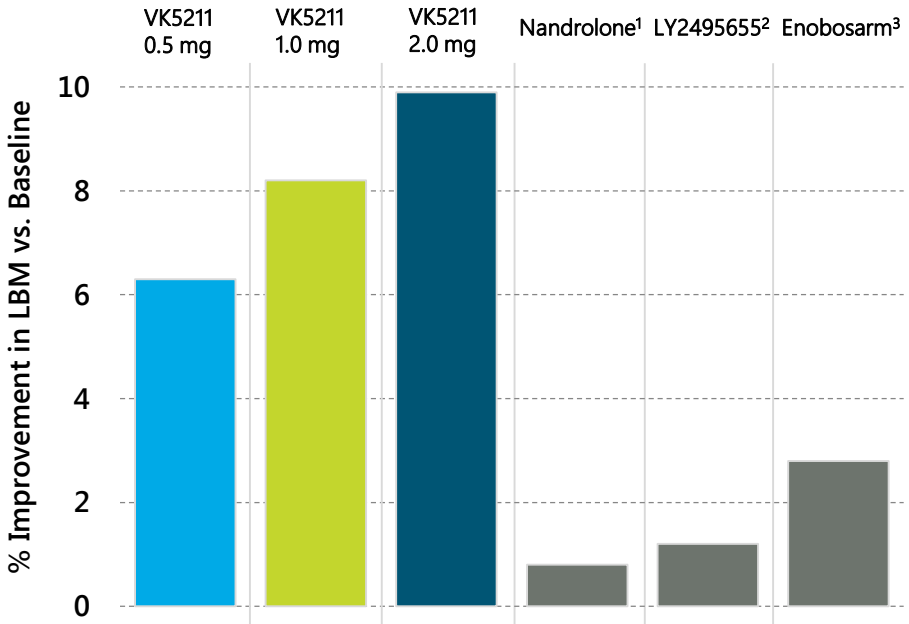
VK5211 Demonstrates Potency Advantages to Other Mechanisms

- Significantly greater potency relative to testosterone analogs
- Improved potency on muscle compared with myostatin-targeting approaches
- Competitive effect on total lean body mass relative to other clinical-stage SARMs

Reported Changes in Total Lean Body Mass in Older Adults



	VK5211 0.5 mg	VK5211 1.0 mg	VK5211 2.0 mg	Nandrolone[1]	LY2495655[2]	Enobosarm[3]
% Difference:	6.3%	8.2%	9.9%	0.8%	1.2%	2.8%
p-value:	<0.005	<0.001	<0.001	<0.05	0.02	<0.001

VK5211 in older adults provides increases in lean body mass that compare favorably to other developmental mechanisms

1) Change in LBM at 6 months in hip fracture patients. *Clin. Nutrition*, 2004, 23, 587-596 2) Myostatin antibody. Change in LBM at 12 weeks in older weak fallers. *Lancet Diabet. Endo.* 2015, Dec; 3, 948-957. 3) Change in LBM at 12 weeks in men and women >60 yrs old. *J. Cachexia Sarcop. Muscle*, 2011, 2:153-161.

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VK5211 Phase 2 Study: Overall Safety and Adverse Events

- Encouraging safety and tolerability
- Frequency of reported adverse events demonstrates no dose-relationship
- No drug-related SAEs
- Next steps
  - Exploring partnering and licensing opportunities
  - Plan for next steps in orthopedic settings with partner

Financial Summary

- Capital structure and summary financials

Capital Structure[1]	In '000s
Shares outstanding	71,285
Options, RSUs	2,152
Warrants	6,745
Total shares, options, RSUs, warrants	80,182

Financials[1]	September 30, 2018 ($'000s)
Cash, cash equivalents and short-term investments	$304,162
Debt	-

Notes: 1) As of September 30, 2018.

Corporate Overview

Focused on best-in-class drugs for metabolic and endocrine diseases

- Two Phase 2 programs supported by positive clinical data

Metabolic Disease Program: VK2809 for NASH

- Novel, selective thyroid receptor-β (TRβ) agonist
- Phase 2 results demonstrate significant reduction in liver fat content, lipids

Rare Disease Program: VK0214 for X-ALD

- Potential IND, PoC study to begin 2019

Musculoskeletal Program: VK5211 for hip fracture recovery

- Non-steroidal selective androgen receptor modulator (SARM)
- Phase 2 results demonstrate significant increases in lean body mass

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Corporate Presentation

December 2018