QSM DIAGNOSTICS

A connected health point-of-care diagnostics company for identification of pathogenic bacteria **in minutes**.

Company Overview

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Phil Devlin, CEO
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Ed Goluch, PhD, Founder and President
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INVESTOR HIGHLIGHTS

The way we diagnose bacterial infections is changing

- Large Addressable Markets with Clinically Relevant Unmet Needs
- Differentiated Approach Enables Results in Minutes vs. Hours/Days
- Financially Compelling Business Model with Recurring Revenue
- Phased Entry De-Risks with Initial Focus on Lower Barrier Vet Market
- Experienced Management and Advisory Teams
- Strong IP Position with Technology and Licensing Flexibility
- Clinical Validation Demonstrates Proof of Concept

QSM DIAGNOSTICS

QSM Diagnostics, Inc.

Snapshot

- Founded in Oct. 2014
- Technology licensed from
  - Northeastern University, Boston, MA
- 2016 MassChallenge Silver Award Winner
- 2017 Awarded Nation Science Foundation SBIR Grant to develop point-of-care UTI diagnostic test for companion animals
- Commercial launch of veterinary UTI test in 2019

- Raising $2.1M pre-A round to develop and launch veterinary product
- Negotiating term sheet with Strategic investor for seed-investment

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LARGE GLOBAL PROBLEM

Slow test results leads to over-prescription of potentially harmful antibiotics

BACTERIA TEST RESULTS ARE SLOW

Standard of care requires:

- 1-2 days for results
- Centralized lab for processing
- Expensive benchtop equipment
- Separate tests vs. panels

Emerging (PCR) technologies have shortened time to results to 1 hour but are expensive and have poor positive predictive accuracy & are not quantitative.

ANTIBIOTICS OVER-PRESCRIBED

- **About 50% of antibiotics prescribed are unnecessary for both human and animals**
- Healthcare costs = $20B
- Lost productivity costs = $35B
- 250K hospitalizations and 14K deaths are caused by broad spectrum antibiotics

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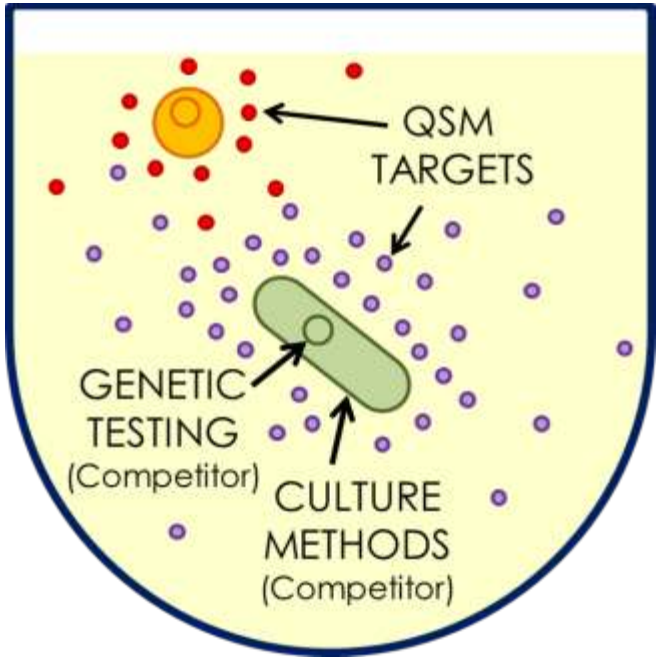
QSM Technology - QUORUM SENSING

Targeting metabolite for faster electro-chemical reaction measurement



- **QSM measures a unique metabolite excreted by each cell**
  - Eliminates sample preparation,
  - **Results in less than two minutes**
  - Requires only **7.5** µL of samples

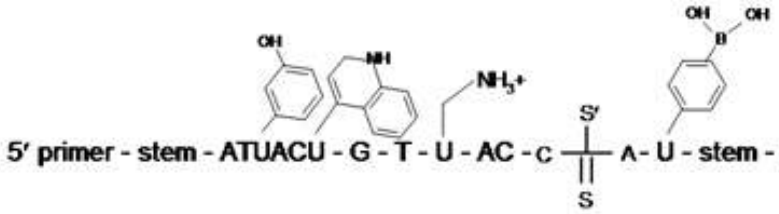
Note: Competitive molecular and biochemical identification methods require cumbersome sample processing

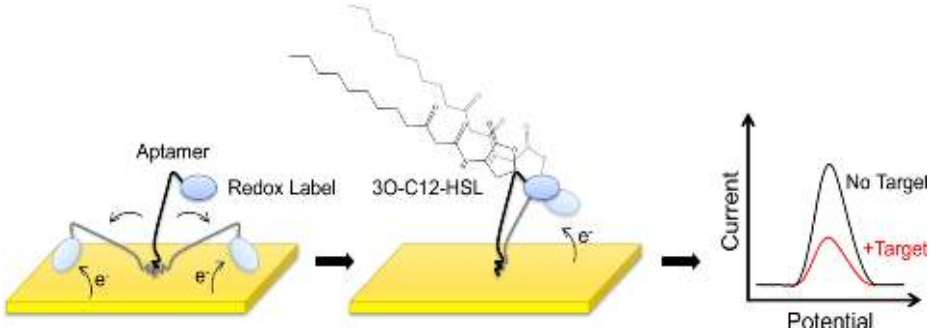
INNOVATIVE COMBINATION

QSM detection, Electrochemistry, X-Aptamers

- **4 orders of magnitude improved sensitivity vs. direct cell detection**
  - **Each bacterial cell produces 10,000 QSMs per hour**
- **Aptamers to detect QSMs do not exist in nature**
  - Each developed aptamer can be patented
  - X-aptamers can provide sensitivity that is better than antibodies used for ELISA
- **Electrochemical sensors of this type can be miniaturized for multiplexed detection**

AMBiotech





The Solution: QSM DIAGNOSTICS

Concept can be applied for any pathogen or biomarker

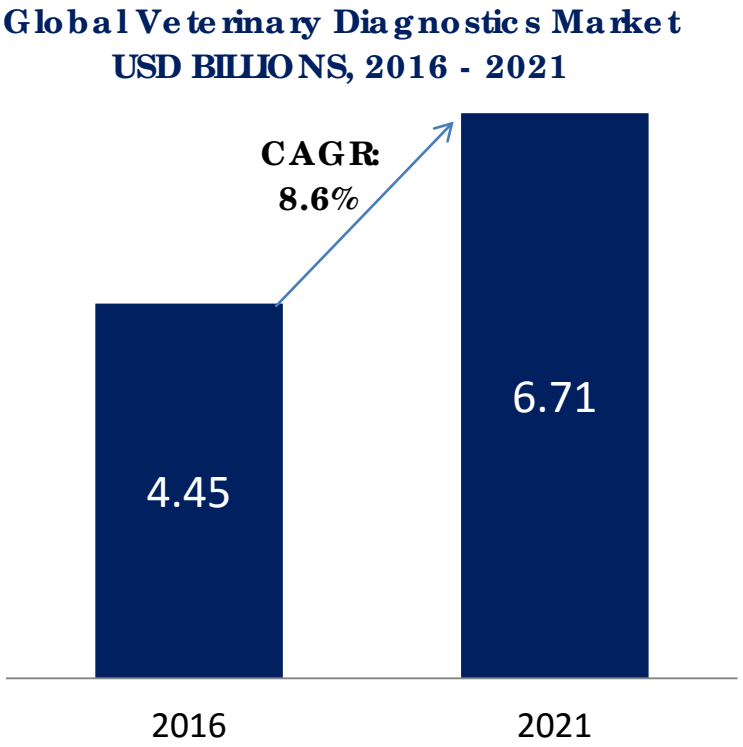
Load Sample → **Operate** → **Results** → **Remote Monitoring**

1. **Load sample of any biofluid onto the sensing surface**
2. **Operate device through simple, modern-designed mobile application**
3. **Results displayed on smartphone in <u>less than 2 minutes</u>**
4. **Results can be immediately available in the cloud**

QSM Sensing Technology can be **adapted to detect <u>virtually any molecule</u> or protein** through the use of aptamers

Veterinary Diagnostics Market

$4.45B market expected to grow at CAGR of 8.6% to reach $6.71B by 2021



Drivers

- Rising animal healthcare expenditure
- Rising pet adoption
- Growing demand for animal-derived food products
- Increasing number of veterinary practitioners and their growing income levels in developed regions
- Increasing demand for pet insurance
- Rising awareness about zoonotic diseases

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TARGET MARKETS: PHASED ENTRY

Speed time to market with initial focus on Vet (lower regulatory hurdles)

Veterinary Diagnostics

$4+B WW

$1.8+B USA

8-10% CAGR

Initial Market:

- Urinary Tract Infection (UTI) diagnostic test
  - WW PAM >$400M
- US Commercial launch in 2019

Human Clinical Microbiology

$7.6B WW

$3.8B USA

13% CAGR

Initial Target:

UTI

Hospital Acquired Pneumonia

(4-5M annual incidence – high cost)

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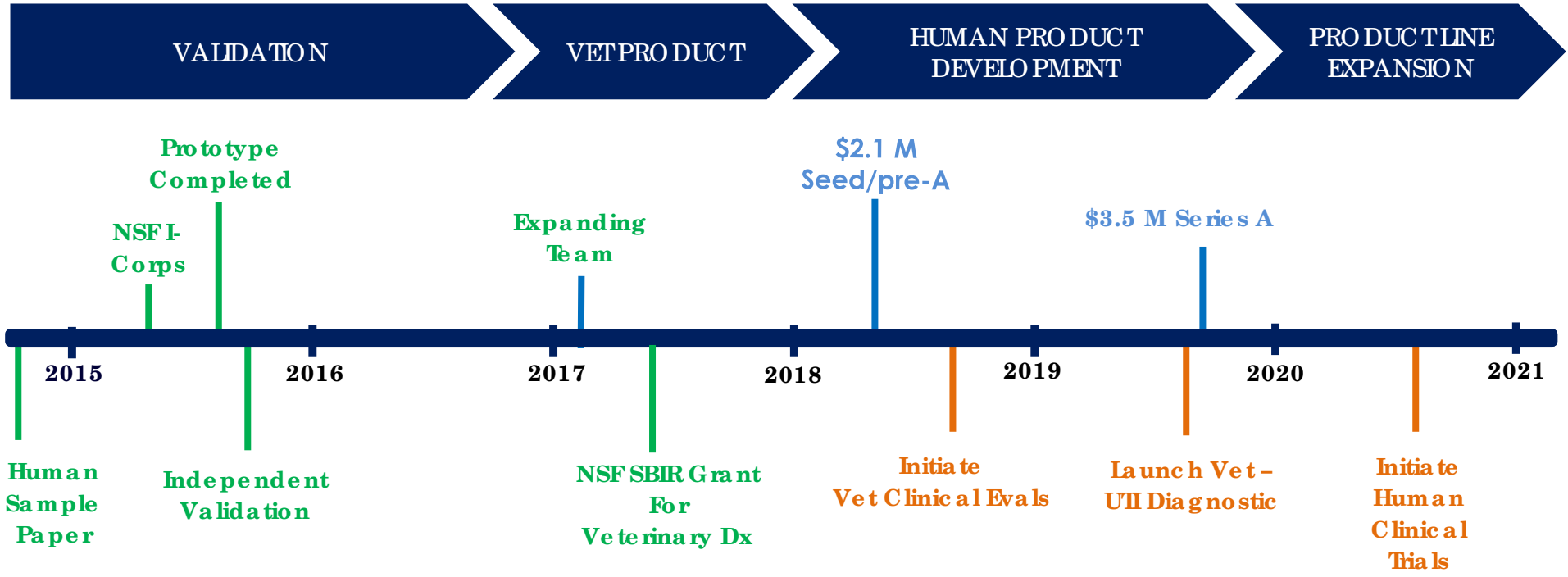
COMPETITIVE LANDSCAPE - Veterinary

QSM is meaningfully differentiated, enabling immediate diagnosis

	Company	Description	Hand Held	Quantitative	Sample to Result	Central Lab
	**QSM**	**Quorum Sensing**	**Yes**	**Yes**	**2 min**	**No**
	IDEXX	Central Lab	No	No	1-2 days	Yes
	Microscan	Biochemical	No	No	1-2 days	Yes
	Lexagene	Genetic (PCR)	No	No	1+ hour	Yes
	Bruker	Mass Spec	No	No	1-2 days	Yes

KEY MILESTONES

Minimal time and investment for market entry



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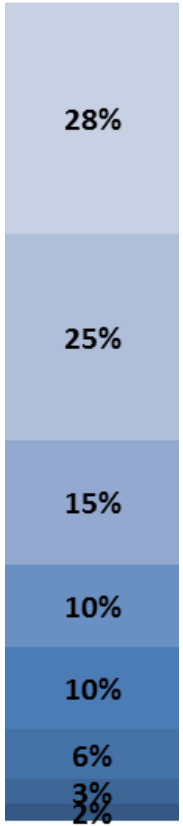
Use of Pre-A Funds

Focusing on technology development to launch Vet product



Microbiologist & engineer (develop: 7 pathogen ID sensor)
- Chemistry for Sensor: AM Biotechnologies, Houston, TX

Outsourced design (milestone: commercial device)
- Instrument: Negotiating deal with international electronics manufacturer
- Sensors Production: Conductive Technologies, Inc. York, PA

C-level management (milestone: manufacturing vet products)

Legal (new patent applications)

Inventory, supplies & sales

Space, regulatory, and accounting

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TEAM

Seasoned team with technical and business development experience

Phil Devlin, CEO

- 30+ yrs experience in medical devices and diagnostics
- Grew start-up to acquisition

Ed Goluch, PhD, Founder/President

- Professor in Chemical Engineering
- 14+ years experience in biosensors

- **Nick Cadirov, PhD,** Director of Engineering
  - PhD Chemical Engineering

- **Rachel Loo,** Intern
  - +1 year at QSM

- **Martin Kimani,** Engineer
  - Inventing next generation sensor tech @NU
  - +2 years with QSM technology

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BOARD OF ADVISORS

Combination of scientific and business expert advisors

Geneve M. Allison, MD, MSc, FACP

- Outpatient intravenous antibiotics for complex infections, general infectious disease, chronic wounds, and wound healing

Virginia Sinnott, DVM, DACVECC

- Emergency and Critical Care Veterinarian, Angell Animal Hospital

Gerald Pier, PhD

- Professor of Medicine, Harvard Med School, Brigham & Women's

Mike Webb

- President & CEO: Tyrogenex, Xcovery, Allegro, Anchor, EPIX

Questions?

Point of Care Diagnostic Testing

PROTECTED TECHNOLOGY

Broad IP protection for multiple markets

- IP developed by Dr. Goluch and team at Northeastern University
- 4 pending patents covering underlying science and technology platform
- Option to license is in place

Northeastern

- Building a portfolio that protects all aspects of the diagnostic system
- Miniaturized sensor with integrated reference
- Functionalized Multiplexed Sensor for detecting many pathogens simultaneously
- Metabolite Up-regulation for earlier detection
- Preventative measures such as continuous monitoring, early detection, and treatment monitoring
- Platform has applications is veterinary, medical, food safety, consumer

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QSM RESEARCH PUBLICATIONS

Comprehensive scientific validation of Quorum Sensing approach

- H.J. Sismaet, A. Banerjee, S. McNish, Y. Choi, M. Torralba, S. Lucas, A. Chan, V.K. Shanmugam, E.D. Goluch. "Electrochemical detection of Pseudomonas in wound exudate samples from patients with chronic wounds." *Wound Repair and Regeneration*. **2016** doi: 10.1111/wrr.12414.
- T.A. Webster H.J. Sismaet, I.J. Chan, E.D. Goluch. "Electrochemically monitoring the antibiotic susceptibility of *Pseudomonas aeruginosa* biofilms." *Analyst*. **2015**, *140*, 7195-7201.
- T.A. Webster, H.J. Sismaet, A.F. Sattler, E.D. Goluch. "Improved Monitoring of *P. aeruginosa* on Agar Plates." *Analytical Methods*, **2015**, *7*, 7150-7155.
- H.J. Sismaet, T.A. Webster, E.D. Goluch. "Up-regulating Pyocyanin Production by Amino Acid Addition for Early Identification of *Pseudomonas aeruginosa*." *Analyst*, **2014**, *139*, 4241-4246.
- T.A. Webster, H.J. Sismaet, J.L Conte, I.J. Chan, E.D. Goluch. "Detection of *Pseudomonas aeruginosa* in Human Samples via Pyocyanin." *Biosensors & Bioelectronics*, **2014**, *60*, 265-270.
- T.A. Webster, E.D. Goluch. "Electrochemical Detection of Pyocyanin in Nanochannels with Integrated Palladium Hydride Reference Electrodes." *Lab-on-a-Chip,* **2012**, *12,* 5195-5201.

Veterinary Market Segments

Largest Segment (Rev)
Highest Future Growth

Immunodiagnostics forecasted to have highest growth due to advances in easy handling, high sensitivity, accuracy, and rapid diagnosis

PRODUCTS

- Consumables
- Instruments
- Services

TECHNOLOGIES

- **Diagnostic imaging**
- Clinical chemistry
- **Immunodiagnostics**
- Hematology
- Molecular diagnostics

END-USERS

- **Reference laboratories**
- Point-of-care testing/in-house testing
  - Veterinary hospitals
  - Veterinary clinics
- Research institutes

ANIMALS

Companion
- Dogs
- Cats
- Others

Food-producing
- Beef cattle
- Dairy cattle
- Pigs
- Poultry
- Others

GEOGRAPHIES

- **North America**
- Europe
- **Asia-Pacific**
- Rest of World

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Veterinary Industry Facts

Overall pet care is a large and growing industry

- $35B spent in US on pets in 2015 for veterinary care, supplies, medicine and boarding/grooming
- 185M pets in US, including about 164M dogs and cats
- Ownership of pets is widespread with 80M or 65% of US households owning at least one pet
- 54M households owned at least one dog and 43 million households owned at least one cat
- Unlike the human healthcare industry, providers of veterinary services are not dependent on third-party payers in order to collect fees
- The practice of veterinary medicine is subject to seasonal fluctuation with greater demand in warmer months
- US market for veterinary servics is highly fragmented with more than 53,000 veterinarians practicing at the end of 2015
- 26,000+ companion animal hospitals operating at the end of 2015 with trend towards consolidation