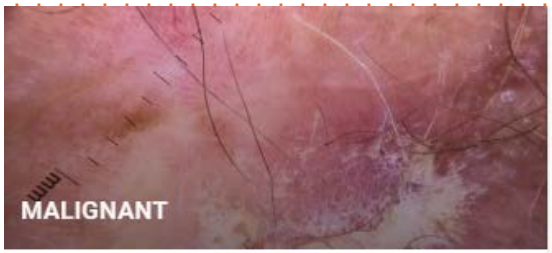
Bostel Technologies

Skin Cancer Diagnostics by Unique Dual Deep Learning Algorithms

Overview & Opportunity

March 2021

www.bosteltechnologies.com



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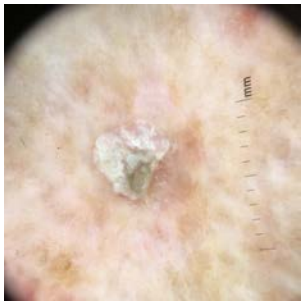
The problem…

- **Skin cancer is common**, with increasing incidence, morbidity, and mortality
- **Diagnosing skin cancer** is inaccurate and involves time-consuming diagnostic procedures
- **Delayed diagnosis** leads to more advanced, more lethal, and more costly cancers
- COVID-19 era: **Diagnostic accuracy** is of poorer quality with less direct physician-patient interactions and regular telemedicine
- **Telemedicine is not supported** by a reliable clinical decision support tool

Skin Cancer is…Common, Increasing, and Harmful

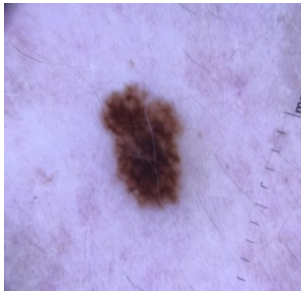
NON MELANOMA SKIN CANCER (NMSC)

- **4,300,000 Basal Cell Carcinomas (BCC) and 1,000,000 Squamous Cell Carcinoma (SCC)** evolve yearly in U.S.
- **1 in 5 Americans** will develop skin cancer by the age of 70
- **2000 people die every year of squamous cell carcinoma** of the skin in the U.S.



MALIGNANT MELANOMA (MM)

- About **195,000 new Melanomas** diagnosed in US each year and 7000 deaths
- Amongst, 95,000 noninvasive (in situ) and 100,000 invasive
- **Melanoma is the most lethal** form of skin cancer, a 1:38 lifetime risk
- >1 million Americans are living with melanoma
- **A delay in diagnosis of MM can cut survival chance by 5-100%**



Diagnosing Skin Cancer is … Inaccurate, Inefficient, and Expensive

Trained dermatologists achieve only 40% detection sensitivity for malignant melanoma; for complex melanomas detection rate is no better than chance J. Eur. Acad. Dermatol. Venereol. 2017 Jun;31(6):972–977

Low accuracy results in needless biopsies, scarring, and economic impact

- MM requires 58 lesions excised to identify 1 melanoma for those aged less than 50, and 28:1 for all ages

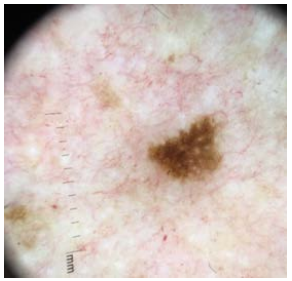
Biopsies are expensive ($3.3 billion/year) and slow (biopsy, pathology, & scheduling ~ 1-2 months)

Biological treatment for advanced stage MM : $300K/2yrs per patient

Benign Nevus

NMSC

Melanoma



Diagnosing Skin Cancer…Impacted by Telemedicine (& COVID-19)

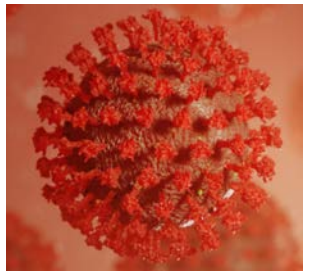
Fewer patients accessing medical services, including dermatology

- Concerns about contracting COVID at doctor's office
- General belief that dermatology "can wait"
- Those treated have a higher histopathological upgrade rate.

Fewer Basal Cell Carcinomas treated during the COVID-19 pandemic

Use of Telemedicine has become mandatory

- A computer-aided diagnosis or decision support system is lacking



COVID-19 restrictions increase wait times and worsen outcomes for patients; require remote engagement of healthcare professionals; and result in higher costs to payers.

The Team…

Bostel Technologies

Development Team

Bruce N. Walker, PhD: Professor of Psychology & Computing, Georgia Institute of Technology (Atlanta)

- Expert in Human-Computer Interaction, sonification, and multimodal user interfaces

Dr. Walker is the President of BosTel Technologies, LLC

Avi Dascalu, MD, PhD: Specialist in Dermatology

- Expert in image and sound analysis

James M. Rehg, PhD: Professor of Computing, Georgia Institute of Technology

- Expert in Deep Learning

Ankur Kalra, MEng: Founder of Hop Labs, Atlanta, GA

- CEO of an artificial intelligence laboratory focusing on software and machine learning development

Eli O. David, PhD: Consultant

- Expert in deep learning and evolutionary computation

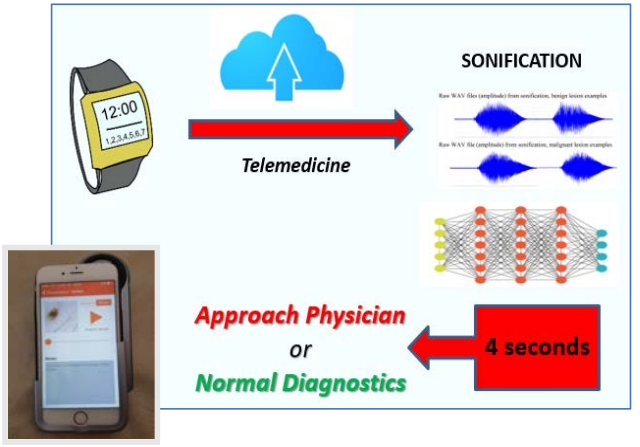
A novel and powerful solution…

Bostel Technologies

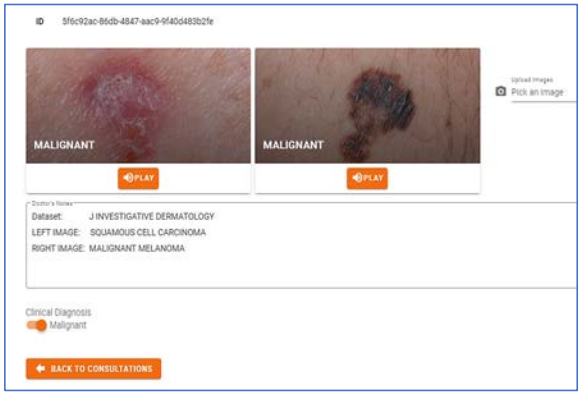
App-Based Diagnosis via *Unique Deep-Learning +& Sonification*

End-to-end classification and diagnosis solution

- Images of lesion captured with smartphone app (with or w/o dermoscope)
- Instantaneous diagnosis (Malignant/Benign) via cloud-based servers
- Unique algorithm: *Deep Learning Image Classifier + Sonification*
- Classifications used as a screening tool by healthcare professionals



- API **operational** and detects BOTH Melanoma and Non Melanoma cancers
- DERMOSCOPIC Sensitivity of 90% for MM and NMSC
- Applicable to either dermoscopic images or smartphone photographs
- Applicable to either professional or home-quality dermoscope

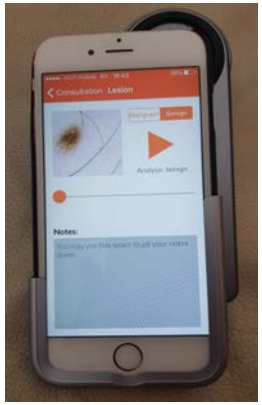


Multiple Use Cases…

Use Case A. Professional Dermoscopy

Dermatologists and/or trained GP's use *phone + dermoscope* with software

- Capture dermoscopic images, pro quality
- Cloud-based diagnosis
- Physician leverages diagnostic results in treatment plan



Professional Demoscope

DermLite DL4

Additional website-based diagnosis tool

- Images uploaded via desktop computer or tablet
- Cloud-based diagnosis
- Physician leverages diagnostic results in treatment plan

Prospective Clinical Study of Sonification algorithm system effectiveness with professional dermoscopic device

- 89.5% Sensitivity for malignant lesions (MM, Dysplastic nevus and NMSC) and 57.8% Specificity

Use Case B. Home Consumer, Dermoscopic add-on

Low cost (100 USD) skin magnifier with polarized light attached to a smartphone

- Directed at a Home user as a smartphone add-on or watch gadget
- Dermoscopic images, of moderate quality

Tested in a **Prospective Clinical Study** and validated by peer review
eBioMedicine publication: https://doi.org/10.1016/j.ebiom.2019.04.055

- 91.7% Sensitivity for malignant lesions (MM, Dysplastic nevus and NMSC) at 41.8% Specificity
- Our system **identifies even small melanomas**

DermLite HÜD

Home Dermoscope

Validation…

Prospective Clinical Study

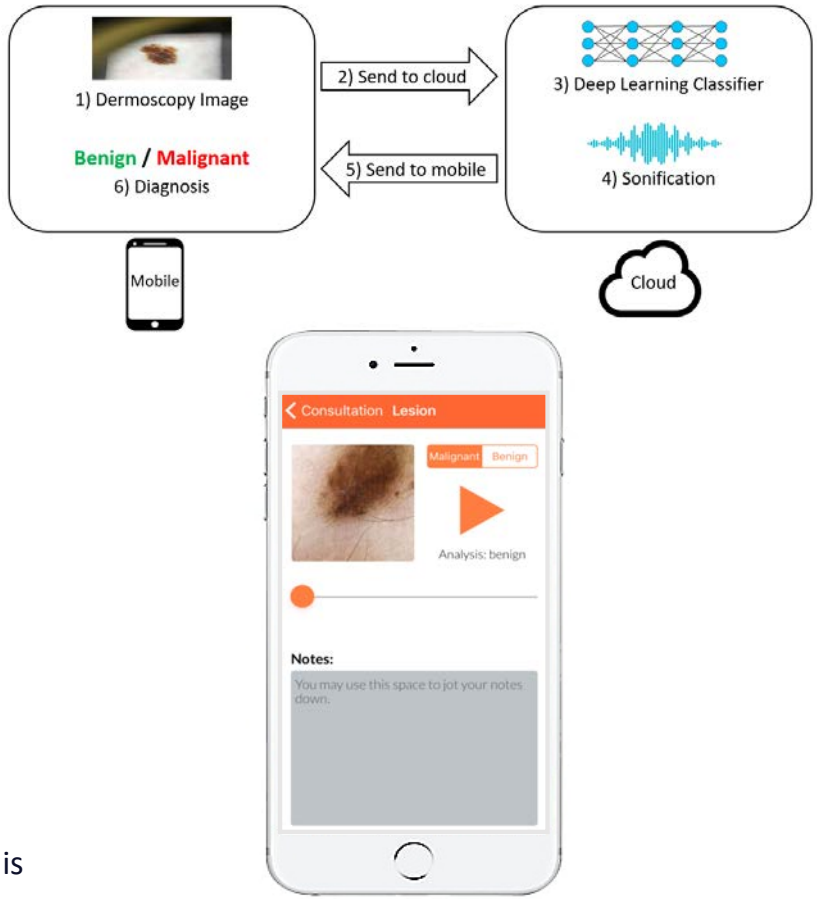
IRB approved clinical study performed at healthcare provider (Maccabi, Israel)

- N=75 subjects
- All skin lesions recorded by both professional and home dermoscope
- App sent images to/from cloud, near instantly
- Results reported as benign (normal/dysplastic nevi) or malignant (MM and NMSC)

Audio/Visual Classifier using our *Unified Model* identified skin cancer (small Melanoma and NMSC) with:

Sensitivity 93.3%

Specificity 68.3%



Cited in ***Nature*** as one of only 11 clinical trials of AI in medicine that is randomized and conforms to new guidelines for AI clinical research.

Topol, E.J. Welcoming new guidelines for AI clinical research. Nat Med 26, 1318–1320 (2020). https://doi.org/10.1038/s41591-020-1042-x

Key publications in *The Lancet* and *ICAD*

EBioMedicine
Published by THE LANCET

EBioMEdicine; February 2019, Volume 40, Pages 176–183
https://doi.org/10.1016/j.ebiom.2019.01.028

EBioMedicine
Published by THE LANCET

EBioMEdicine; May 2019, Volume 43, Pages 107–113
https://doi.org/10.1016/j.ebiom.2019.04.055

ICAD

International Conference on Auditory Displays (ICAD); June 2019
http://hdl.handle.net/1853/61501

EBioMedicine
Published by THE LANCET

EBioMedicine – manuscript in preparation regarding NMSC success

Patent filings under prosecution with USPTO

Serial No.	Filing Date	Title	Status	OLG Ref. No.
16/311,372	12/19/2018 (06-26-17)	PHONODERMOSCOPY, A MEDICAL DEVICE SYSTEM AND METHOD FOR SKIN DIAGNOSIS	Pending National Phase in US (30 month)	637-01-UTIL-07
17820991.2	1/23/2019 (06/26/2017)	PHONODERMOSCOPY, A MEDICAL DEVICE SYSTEM AND METHOD FOR SKIN DIAGNOSIS	Published National phase in EP (31 month)	637-01-EP-08
62/688,062	06/21/2018	DERMOSCOPY DIAGNOSIS OF CANCEROUS LESIONS UTILIZING DUAL DEEP LEARNING ALGORITHMS VIA VISUAL AND AUDIO (SONIFICATION) OUTPUTS	Pending and to be filed as CIP by 6/21/2019	637-04-PROV
62/765,042	08/17/2018	DERMOSCOPY DIAGNOSIS OF CANCEROUS LESIONS UTILIZING DUAL DEEP LEARNING ALGORITHMS VIA VISUAL AND AUDIO (SONIFICATION) OUTPUTS	Pending combine with 62/688,062	637-05-PROV

Current Operational and Development Status

- Bostel founded in 2016 as Delaware LLC. Headquarters in Atlanta; additional teams in Boston and Israel
- Atlanta-based development team and cloud servers
- App and web-based interface – operative
- Registration strategy mapped
- Validation by Prospective Clinical Study
- Validation by 3+ peer-reviewed articles

The Opportunity …

Bostel Technologies

Market Size and Competitive Landscape

The global dermatology diagnostic device market is expected to exceed $5.0 billion by 2026 at a CAGR of 7%. Market Research Engine. Dermatology Diagnostic Devices by market by product analysis. December 2018

Bostel Technologies' skin cancer diagnosis technologies are more robust, more flexible, more rigorously validated, and easier to use.

SkinVision was evaluated in three studies (n=267, 66 malignant or premalignant lesions) and achieved a sensitivity of 80% … and a specificity of 78%. However, it seems to be unreliable with 45% rate of non diagnostics. App has only moderate ratings.

Skin Analytics device study leaves open critical questions: Study looked for and identified only BIG MELANOMAS (>76%), which can easily be accurately identified by an unaided human eye.

Variable	Category	.	Percent
Lesion diameter (Geometric mean diameter=6.75 mm (6.49-7.02))	< 5 mm	110	20.0%
	5-9 mm	266	48.3%
	10-14 mm	155	28.1%

British J Medicine, 2020 DOI: 10.1136/bmj.m127 10 Feb 2020

Development Pathways

OPTION A. Dermoscopic Home Device (9-12 mo)

Professional-grade diagnostic capability, available via smartphone app and low-cost accessory.
PMA 3 approval.

Pivotal clinical study of 1500 biopsies, **9-12 mo** to approval for NMSC (see Nevisense, SciBase, AB, 2015)

Start of agreements & sales within **12 mo**

API

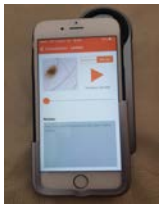
OPTION B. Professional Diagnostic Tool (18-24 mo)

Cutting Edge Clinical Decision Support, leveraging professional dermoscope.

Developed for GPs/Dermatologists
Fast track. PMA 3

Pivotal clinical study of 1500-2000 biopsies, **18-24 mo** to approval for MM (see Nevisense, SciBase, AB, 2015)

Start of agreements & sales within **24 mo**.



OPTION C. Consumer App (60 days)
(dermoscopic images AND/OR smartphone photos)

Application on Play/Apple Store,
immediate start of revenues stage

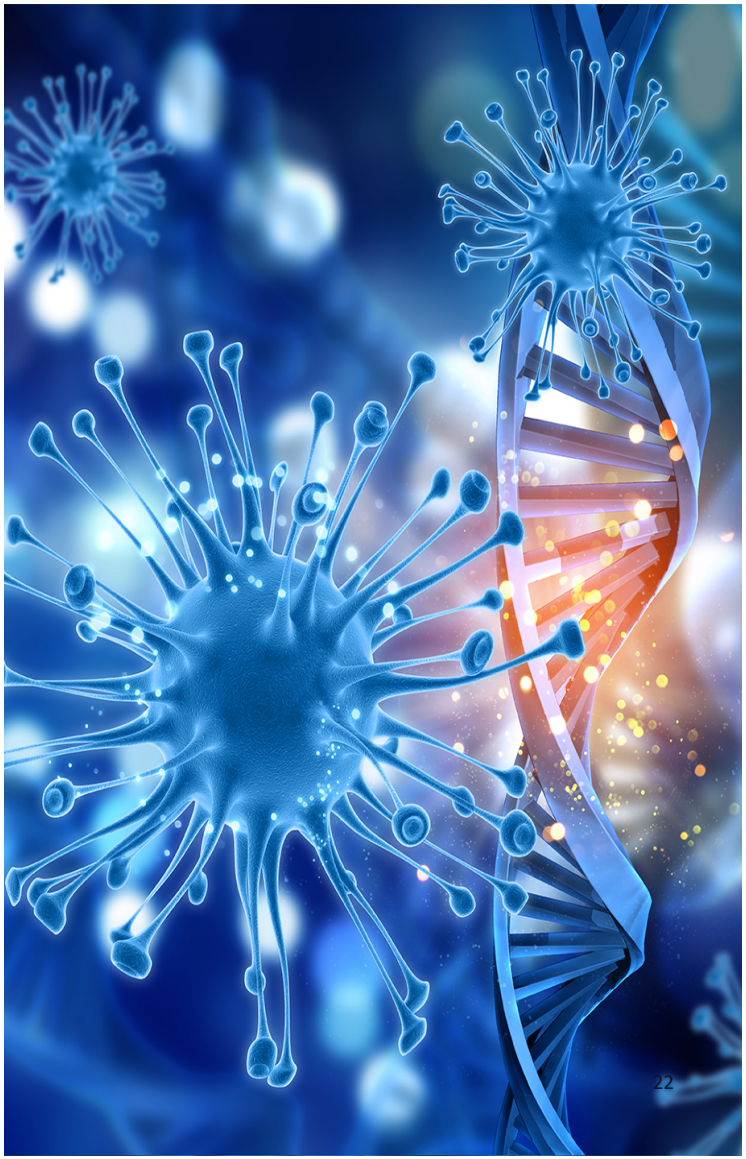
Opportunity

Bostel Technologies is seeking strategic options for its platform and business

Current investment opportunity:

Bostel Technologies LLC achievements

- **Web-based API operative,** for instantaneous diagnostics
- **Unique and powerful technology** advantage: Dual deep learning algorithms using Image Classifier and Sonification
- Suitable for Home and Professional usage
- Targets GP's
- Applicable to both dermoscopic images and smartphone photos
- Diagnostic high accuracy validated by three **scientific publications**
- Internationally validated **Prospective Clinical Study**



Thank You!

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