Strategic Planning Workshop: Biosciences September 23rd at Arizona Inn

Name	Email	Title	Affiliation
David Allen	DavidA@tla.arizona.edu	Vice President	Tech Launch Arizona
Parker Antin	pba@email.arizona.edu	Associate Dean, Research	College of Agriculture and Life Sciences
David Armstrong	DGA@email.arizona.edu	Professor	Surgery
Neal Armstrong	nra@email.arizona.edu	Associate Vice President	Office for Research & Discovery
Craig Aspinwall	aspinwal@email.arizona.edu	Associate Professor	Chemistry and Biochemistry
Bhaskar Banerjee	bbanerjee@deptofmed.arizona.edu	Professor	Medicine
Carol Barnes	carol@nsma.arizona.edu	Professor	Psychology
Jennifer Barton	barton@email.arizona.edu	Associate Vice President	Office for Research & Discovery
Lyle Bootmant	bootman@pharmacy.arizona.edu	Dean	Pharmacy
Leslie Boyer	boyer@viper.arizona.edu	Director	Viper Institute
Jeff Burgess	jburgess@email.arizona.edu	Associate Dean, Research	Public Health
Shane Burgess	sburgess@cals.arizona.edu	Dean	College of Agriculture and Life Sciences
Charles Cairns	cairnsc@email.arizona.edu	Interim Dean	College of Medicine - Tucson
Todd Camenisch	camenisch@pharmacy.arizona.edu	Associate Professor	Pharmacy and Toxicology
Andrew Capaldi	capaldi@email.arizona.edu	Assistant Professor	Molecular and Cellular Biology
Nathan Cherrington	cherrington@pharmacy.arizona.edu	Professor	Pharmacy and Toxicology
Elliott Cheu	echeu@email.arizona.edu	Associate Dean, Research	College of Science
Clara Curiel	ccuriel@email.arizona.edu	Associate Professor	Medicine
Erika Eggers	eeggers@email.arizona.edu	Assistant Professor	Biomedical Engineering & Physiology
Nathan Ellis	naellis@email.arizona.edu	Associate Professor	Cellular and Molecular Medicine
Eniko Enikov	enikov@engr.arizona.edu	Professor	Aerospace and Mechanical Engineering
Brian Enquist	benquist@email.arizona.edu	Professor	Ecology and Evolutionary Biology
Claudio Estrada Garcia	cestradagasca@email.arizona.edu	Visiting Scholar	Office of Global Initiatives
Ken Feldman	feldmann@email.arizona.edu	Professor	Plant Sciences
Stuart Flynn	flynns@email.arizona.edu	Dean	College of Medicine - Phoenix
David Galbraith	galbraith@arizona.edu	Professor	Plant Sciences
Skip Garcia	skipgarcia@email.arizona.edu	Senipr Vice President	Health Sciences
Neel Ghosh	ghosh@email.arizona.edu	Professor	Chemistry and Biochemistry
Rakhi Gibbons	RakhiG@tla.arizona.edu	Asst. Dir., Biomed. & Life Sci. Licensing	Tech Transfer Arizona
Art Gimitro	gmitro@email.arizona.edu	Department Head	Biomedical Engineering
Jeff Goldberg	jbgoldbe@email.arizona.edu	Dean	College of Engineering
Felicia Goodrum	fgoodrum@email.arizona.edu	Associate Professor	Immunobiology
Carol Gregorio	gregorio@email.arizona.edu	Department Head	Cellular and Molecular Medicine
Iman Hakim	ihakim@email.arizona.edu	Dean	Public Health
Mike Hammer	mfh@email.arizona.edu	Research Scientist	Arizona Research Labs
Julia Indik	jindik@email.arizona.edu	Associate Professor	Medicine
John Jewett	jjewett@email.arizona.edu	Assistant Professor	Chemistry and Biochemistry
Mike Jonen	mjonen@email.arizona.edu	Senior Associate Vice President	Health Sciences
Rick Kittles	rkittles@email.arizona.edu	Professor	Surgery
Khanh Kleu	kkieu@optics.arizona.edu	Assistant Professor	College of Optical Sciences
Tom Koch	tlkoch@email.arizona.edu	Dean	College of Optical Sciences
Anita Koshy	akoshy@email.arizona.edu	Assistant Professor	Neurology/Immunology
Dan Latt	dlatt@email.arizona.edu	Assistant Professor	Orthopaedic Surgery
Serrine Lau	lau@pharmacy.arizona.edu	Professor	Pharmacy
Christina Laukaitis	cmlaukai@email.arizona.edu	Assistant Professor	College of Medicine
Frank Lederman	FrankLederman@comcast.net	Facilitator	
Kristen Limesand	limesank@u.arizona.edu	Professor	Nutrition
Sean Limesand	limesand@ag.arizona.edu	Professor	Animal & Comparative Biomed. Sci.
Lalitha Madhavan	lmadhavan@email.arizona.edu	Assistant Professor	Neurology
Fernando Martinez	fernando@arc.arizona.edu	Director	BIO5 Institute
Joanna Masel	masel@u.arizona.edu	Associate Professor	Ecology and Evolutionary Biology
Justina McEvoy	justinamcevoy@email.arizona.edu	Assistant Professor	Molecular and Cellular Biology
Anne McGuigan	amcguigan@email.arizona.edu	Director, Research Development	Office for Research & Discovery
Usha Menon	umenon@email.arizona.edu	Associate Dean, Research	College of Nursing
Julie Miller	juliemiller@email.arizona.edu	Assistant Professor	Neuroscience & Speech & Hearing Sci.
Terry Monks	monks@pharmacy.arizona.edu	Associate Dean, Research	Pharmacy
Bijan Najafi	bnajafi@email.arizona.edu	Associate Professor	Surgery
Val Nfonsam	vnfonsam@surgery.arizona.edu	Assistant Professor	Surgery
Alan Nighorn	nighorn@neurobio.arizona.edu	Department Head	Neuroscience

Janko Nikolich-Zugich	nikolich@email.arizona.edu	Department Head	Immunobiology
Jon Njardarson	njardars@email.arizona.edu	Associate Professor	Chemistry and Biochemistry
Melynda Noble	melnoble@email.arizona.edu	Administrative Associate	Office for Research & Discovery
Robert Norwood	rnorwood@optics.arizona.edu	Professor	College of Optical Sciences
Lynn Oland	oland@email.arizona.edu	Research Scientist	Neuroscience
Marty Pagel	mpagel@u.arizona.edu	Director	Cancer Imaging
Klearchos Papas	kkpapas@surgery.arizona.edu	Professor	Surgery/Transplantation
Leilei Peng	lpeng@optics.arizona.edu	Assistant Professor	College of Optical Sciences
Kristen Pogreba Brown	kpogreba@email.arizona.edu	Assistant Professor	College of Public Health
Frank Porreca	frankp@email.arizona.edu	Professor	Pharmacology
Ken Ramos	ksramos@email.arizona.edu	Associate Vice President	Precision Health Sciences
Joaquin Ruiz	jruiz@email.arizona.edu	Dean	College of Science
Scott Saavedra	saavedra@email.arizona.edu	Professor	Chemistry and Biochemistry
Tricia Serio	tserio@email.arizona.edu	Department Head	Molecular and Cellular Biology
Joan Shapiro	jshapiro@email.arizona.edu	Associate Dean, Research	College of Medicne - Phoenix
Joan Shaver	jshaver@email.arizona.edu	Dean	Nursing
Rick Silva	RickSilva@email.arizona.edu	Executive Director	Biomed. Corp. Alliances, Health Sci. Ctr
Marvin Slepian	slepian@email.arizona.edu	Professor	Medicine
Brian Ten Eyck	bteneyck@email.arizona.edu	Associate Dean, Research	College of Engineering
Elisa Tomat	tomat@email.arizona.edu	Assistant Professor	Chemistry and Biochemistry
Ted Trouard	trouard@email.arizona.edu	Associate Professor	Biomedical Engineering
Jonathan Vande Geest	jpv1@email.arizona.edu	Associate Professor	Aerospace and Mechanical Engineering
Koen Visscher	visscher@email.arizona.edu	Associate Professor	Physics
Justin Walker	juswalker@email.arizona.edu	Associate Dean, Research	College of Optical Sciences
Mike Worobey	worobey@email.arizona.edu	Department Head	Ecology and Evolutionary Biology
Andre-Denis Girard Wright	adwright@email.arizona.edu	Director	Animal & Comparative Biomed. Sci.
Jeong-Yeol Yoon	jyyoon@email.arizona.edu	Associate Professor	Agricultureal-Biosystems Engineering
Jason Yuan	jasonyuan@email.arizona.edu	Associate Vice President	Translational Health Sciences
Michele Zacks	mzacks@email.arizona.edu	Associate, Research Development	Office for Research & Discovery
Daniela Zarnescu	zarnescu@email.arizona.edu	Associate Professor	Molecular and Cellular Biology
Frederic Zenhausern	fzenhaus@email.arizona.edu	Director	Ctr for Appl. NanoBioscience & Medicine
Donna Zhang	dzhang@pharmacy.arizona.edu	Professor	Pharmacy and Toxicology

Attendees' names in green; other invitees in red

Biosciences Strategic Planning Workshop
Whiteboard Notes – Sept. 23

Physical Infrastructure:

- App development
- Prototype fabrication (with various materials; with speed)
- Sharing and managing data cross-campus
- Repository for biological samples and specimens
- Bioinformatics core facility for analysis of data
  - Build on iPlant infrastructure
- Centralized omics facilities
- Sophisticated mass spectrometer

Other Needs and Issues:

- Catalog of capabilities and facilities
- Catalog / tagging of research grants
- Faculty to lead large programs
- User-friendly research support infrastructure (like Duke)
- Networking
- Embedded MDs and faculty
- Coordination of strategic hiring and cluster hires
- Banner-related issues, including:
  - Separate internal review boards
  - Ownership of samples and intellectual property

Strategic Planning Workshop

Translational Biosciences

September 23, 2015

Jennifer Barton

Goals for Day Two

- Breakout sessions for each program theme (2 x 70 min)
- Report-backs to entire group
  - *What are the most exciting ideas?*
  - Summarize key results & issues
  - What items need further work?
- Group discussion
  - Review strategic issues and common resource needs
  - Develop action plan

Breakout Sessions – Key Topics

- What makes (or could make) us unique?
- What grand challenges are addressed?
- What new strategic technical capabilities?
  - What new competitive advantage?
  - What can we demonstrate in the short-term?
  - How can capabilities be extended to other parts of the university?
- Specific opportunities for external funding
- Resources required
  - Program-specific
  - Infrastructure
- What partnerships can help us?
- Other program risks
- Strategic issues

We Need a Strategy to:

- Support the vision and/or strategy of parent organization
- Guide allocation of resources
  - What will grow and what will shrink?
- Show focus
- Inspire objectives that are *required* to achieve the vision
- Help unify the organization around a common set of goals

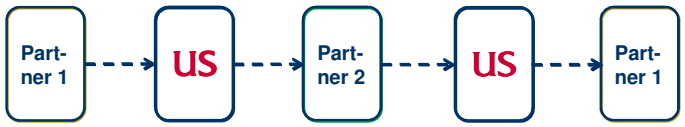
Strengths and Weaknesses

- **Internal focus – emphasis on competitive capabilities**
- **What are our core competencies?**
  - Transcend several departments or groups
  - Provide true competitive advantage / differentiation
  - Produce a barrier for others to enter
- **Examples**
  - Unique facilities difficult and/or expensive to duplicate
  - Unique skills, such as a critical mass of talent in one area that took years to establish
  - Local climate / ecology
  - Key partnerships / relationships
  - Weaknesses: resource limitations in required areas

What can we do?

Strategic Relationships

- **Analyze the skills / facilities needed for your program to be successful**
  - For what capabilities / stages are we truly the best?
  - We can afford to be the best for only one or two stages
  - Who is the best for the other stages (our gaps)?



- **Analyze the strategy for possible partners**
  - What is *their* strategy for their gaps (why they need us)?
  - If they won't tell us, put ourselves in their shoes & guess

A mutually-strategic relationship is a competitive advantage

Opportunities and Threats

- External focus
- What are the external forces affecting your organization?
  - What changes have you seen and do you envision?
- Examples
  - Evolving model for competing for federal funding
  - New budget constraints
  - Changing demographics for students, legislature, philanthropy, …
  - Changes in partners and / or their strategies
- What are the strategic options to respond?
  - What strategic capabilities are required?
  - Which programs should grow? Which should shrink?

What should we do?

Breakout Session Locations

A. Age and Age-Related Diseases
- African Room East

Tricia Serio and Janko Nikolich-Žugich

B. Omics Tech – Genomics and Beyond
- African Room West

Craig Aspinwall and Andrew Capaldi

C. Human Augmentation
- Safari Room

D. Armstrong, M. Slepian and J-Y Yoon

D. Infectious Disease and Microbiome Science
- Safari Room Foyer

Mike Worobey and Andre Wright

Breakout Session A

Aging & Age-Related Diseases

Tricia Serio and Janko Nikolich-Žugich

What Make Us Unique?

- Cover spectrum from molecular mechanisms to community outreach to models of care to public health (no other place in the world has that)

  Aging is a cross-cutting theme to tie together other areas of strength
- Unique population (>65% over 65) access/community partnerships/ clinical access
- Unique environment (arid land, climate, microbiome etc.)
- Two medical schools with access to different populations
- AZ Alzheimer's Consortium
- Center on Aging – as a nucleus for cross-disciplinary interaction

What Grand Challenges Are Addressed?

- **Economics of aging-related degenerative disease**
  – unless resolved, tens of millions will age with multiple chronic conditions and poor healthspan

- **Expand Healthspan and Resilience (productivity, health care savings)**

External Funding?

- Dissemination and Implementation Science (HRSA)
- CTSA
- T32 Aging (one or more; one perhaps with imaging)
- Brain Initiative
- Geroscience RFAs – NIA, NIH
- PPG
- Glenn Foundation
- Integration into developing U19, U54 awards
- RFAs to expand research into age-related intersections

What New Strategic Capabilities?

- Expand clinical syndromes to molecular diagnoses using functional 'omics and chemical biology
  - HT genomic sequencing
  - Gene expression profiling
  - Proteomics
  - Inflammomics
  - Metabolomics
  - Lipidomics
  - Proteostasis
  - Imaging
  - Wearable sensors

Early Demonstration of Capabilities?

- Connecting systems biology to clinical aging and aging-related Disorders
- Development of Biomarkers
- Models of team science
- Measures of community engagement/ health disparities/equities

Partnerships?

- Retirement Community Housing Developers
- Retirement Communities
- Barrow – large clinical base
- Banner

Resources Required?

- Enhanced capabilities in functional 'omics
- Connecting Parts : Support for workshops/retreats
- Tagging grants to identify internal partners
- Coordinating for community engagement
- Pilot funding for connecting clinical syndromes to molecular analyses
- Partnerships for biobanking/documenting existing clinical cohorts
- Support/central templates for ICR distribution issues
- Coordination between SVPs, including faculty recruitment related to PPG
- Cluster hires initiative across AHSC/main campus
- Enhanced communication and integration of iPlant capabilities with broader campus
- Support for data sharing on campus

Risks/Strategic Issues?

- Spreading resources
- Partnerships with multiple clinical entities
- Shallow depth in cross-connections, particularly on the basic biology side

SPECIFIC SVPR ACTION ITEMS

1. Conference – Aging and Resilience, Disparities and Equities workshop with self-assembly.
2. Pilot funds to connect clinical aging and its diseases to cell & molecular biology & 'omics (E.g. resilience-frailty-biosensors-biomarkers)
3. Data sharing – deposit datasets for use by UA community
4. Cohort cross-listing – assemble a list of active or past projects with substantial and shareable human materials from patient cohorts
5. Get the intellectual input on re-purposing material from #4 (weekend troubleshooting, small group).
6. Coordinate outreach- make sure that individual units address older adult communities constantly and systematically.
7. Coordinate strategic hires with AHSC.

Breakout Session B

Omics Technology

Craig Aspinwall and Andrew Capaldi

Genomics, Proteomic and Metabolic is now to key to progress in translational research. It is needed for discovery based research and often are immediately translated into the clinic.

Strengths

- Many top notch basic and clinical research programs and labs
- Positioned to answer unique translational research questions due to region and demographics.
- Moving forward in these areas clearly requires the application of Omics technologies

The U of A has unique strengths in many areas of basic and clinical research, and interesting aspect of discussions this morning were that most if not all clinical researchers felt that genomic and proteomic approaches would help them both with their research and there was an universal desire to have these approaches.

Strengths

- Campus has strength in genomic technologies.
- We have been successful and have clear models for setting up discovery centers (core facilities) on campus.
- Enormous opportunity for growth across campus

Roadblocks

- Missing support for array technology (SNP mapping, etc.)
- Overburdened and dated proteomics and metabolomics capability campus wide.
- BIOINFORMATICS SUPPORT LACKING
- Lack of a facility directory and knowledge of campus wide capabilities
- Lack of faculty specializing in proteomics and metabolomics—pushing the technology forward

Consequences

- Problems with faculty recruitment
- Significant outsourcing (lost revenue)
- Poor quality (limited) studies

- Issues with grant applications
- Many good experiments just don't get done

Recommendations

- Expansion of core capabilities for proteomics and metabolomics
- Central database (and handbook) for Omics capabilities.
- Centralize Omics facilities
- Workshops and recruitment strategies to enhance user pool (timing).
- Bioinformatics Core

Returns

- Strengthen basic research
- Introduction of clinical Omics (precision medicine) to hospital
- Improved grant funding (especially center grants)
- Faculty recruitment

Breakout Session C

Human Augmentation – Needs, Devices, Systems, Strategies and Approaches

David G. Armstrong MD , Jeong-Yeol Yoon Ph D, Marvin J. Slepian MD

Background

We live in a world where the interface between work and play has been blurred. Regardless of socioeconomic strata, today people are connected. Since 2014 there are more cell phones than people and the "reproduction rate" of these devices is 5x that of man! In parallel with this there has been an explosion in electronic consumer personal devices – from pendants, to bracelets, to watches. All told we are connected and we are measuring and monitoring a wide variety of parameters and communicating this information widely. As such we are in the midst of a shift in society - people desiring *to be informed and to inform* on matters of their social and health status.

In parallel with this society shift has been a shift in the nature of human illness. Indeed, the last decade was the first in the history of man in which more people died from non-communicable diseases (NCDs - *including diabetes, cancer, heart and lung diseases*) than from all of the plagues of the world combined. While not discounting the central importance of infectious disease in our immediate future, the rise of NCDs represents a fundamental, if sinister and silent, tectonic shift in the natural history of our species. This increase in chronic disease burden has been a further stress to society as well as to the all elements of the "apparatus" of the health care system. As such novel solutions are needed to address these growing stresses.

It is becoming clear that a solution to many of the evolving issues, that is tightly coupled and aligned with the direction and momentum of present society and device evolution, is to more objectively *measure and manage* how humans interact with their environment – in both wellness and in disease. What we are suggesting, and what is emerging, is to "wire humans" and to even possibly "augment humans" through a synergy of device, materials and pharmacologic means. Today, the lines between medical devices, consumer electronics and tech have become blurred. Also becoming blurry is how we define what makes us…us. From medical tattoos to wearable robots to always-on computing to memory engineering to next-gen implants and device-drug combinations, we are arguably living in a time more exciting and innovative than at any in our history. The big idea is this: Perhaps we can improve people's *reality* - whether well or sick, by physically augmenting their *humanity*.

In this session we will explore the needs, discuss possible solutions and identify capabilities and skills needed to effectively lead in this arena.

1. What makes us (U of A) unique?

Exploring big questions and related small ones that can benefit from the a synergy of device, materials, electronics, and pharma makes the need for a collective group of scientists, clinicians, engineers, legal experts, policy makers, sociologists and philosophers all the more vital. While some interdisciplinary groups have been working on this for some time, we think that we at the University of Arizona are well poised to take a novel approach to these issues.

The University of Arizona presently has significant expertise, international leadership and proximate capabilities as follows:

- Focused faculty experts – leaders in their respective fields and several true cross-disciplinary experts
- Unique populations – aged, chronic dz, top 20 Diagnoses, military (base), athletes – UA teams. Trainees in town – cycling, golf, tennis
- Medicine – broadly all specialties, $3^o/4^o$, proximity/access to main campus
- Base technology capabilities – sensors, EE, others – *need to catalogue*
- Artificial organs
- Wearable computing
- Human motion in aging and chronic disease
- Omic signatures
- Chemical signatures
- Tissue repair and regeneration
- Flexible, stretchable, transient and piezo electronics
- Imaging / Hyperspectral (Optics)
- Cybersecurity of implantable devices
- Artificial intelligence
- Machine Learning
- Big Data
- Novel pharma development
- Point-of-care devices
- Biosensors, Chemical sensors
- Translational capabilities – ACABI, TLA

2. What grand challenges are being addressed?

The overall grand challenge is how to best synergize the emergence of novel materials, devices, electronics, wearables and pharm with the desire to improve the human condition – both in wellness and in decay and decline and in chronic disease

<u>Specific</u> targets include:

- Improved performance of the well
- Prevention of decline/decay with age
- Monitoring and intervention in the ill – particularly those with chronic disease that is a major burden to the health care system
- Health care optimization – new models, home/outpatient

The identified top targets (by CMS) include:
(see https://www.medicare.gov/hospitalcompare/Data/30-day-measures.html)

- Heart attack (AMI) patients
- Chronic obstructive pulmonary disease (COPD) patients
- Heart failure (HF) patients
- Pneumonia patients
- Stroke patients
- Diabetes and its complications
- 30-day unplanned readmission after discharge from the hospital (hospital-wide readmission) - Includes patients admitted for internal medicine, surgery/gynecology, cardiorespiratory, cardiovascular, and neurology services. It's not a composite measure.

If we had a bolus of funds would:

Take top Dx
Take top DOCs
Overlay AZ uniqueness – Healthcare disparities ***then***

Identify Key unmet needs ***then***

1. Develop apps/free ware to monitor disease – DEMONSTRATE reality w exiting wearables (APPS CORE) ***short term deliverable***

2. Develop UNIQUE solutions
i.e. Dig deeper – build unique devices – bring the right folks to the table – engineers, scientists, MDs DEMONSTRATE the CAPABILITIES ***DEMOSTRATE THAT THEY MAKE A CLINICAL DIFFERENCE (medium term deliverable)***

3. Go longer – new science - identify limitations – (from the above exercises/activities) - solve the problem e.g. new materials Generates new science (*longer term deliverable*)

All of the above are grant opportunities as well

To create a generic map/strategy of "what the specs are" and who we have for a given problem try the following:
1. Create top down structure (Multi-scale): e.g. society, patient, disease, organ, specific target, molecule – i.e. these are parameters (could define others)
2. Then identify disease for example
3. Then identify the people and technology/skill needed to solve problem – at each of the identified levels of #1 above

The above is a generic employable method to see what is needed and who we have to solve the problem, also who we need to get/ally with
(This strategy is utilized by ACABI BTW)

3. What new technical capabilities will be developed?

- Fabrication of devices and electronic systems – beyond present capabilities
- Integration of systems capabilities
- Modeling and *in silico* development
- Enhanced testing – *in vitro* and *in vivo*
- Software, **app** and control system development
- Novel composite systems combining materials, devices constructs, electronics, pharmaceutical, computing
- Rapid screening systems – pharma targets
- Admin capabilities – see below

What longer-term competitive advantage will be created?

- U of A will have the full spectrum of capabilities to effectively compete for highly competitive proposals that require cutting edge inter-disciplinary capabilities

- U of A will be looked upon as potential **site** for industry co-development partnerships and testing capabilities, to a much greater degree than at present.

What could be an early demonstration of the new capabilities?

- On site testing of novel constructs
- Use of specific devices or systems for examination of specific real world questions – in both wellness and in disease
- Simple **use case examples**

  Take Disease
  Develop best Parameter profile
  Monitor patients
  Show a difference

How can these capabilities be extended to other parts of the university?

- The interdisciplinary teams formed will have applicability to other work as well
- The technical capabilities developed will be translatable as well

4. What are specific opportunities for external funding?

This area crosses many domains that make it well-positioned for extramural funding. These include:

- NIH – R01, U01, R21
- NSF
- Department of Homeland Security
- DARPA
- NIH SBIR/STTR
- Investigator-initiated industry proposals
- Major philanthropic development
- Tech-Launch Arizona / ACABI startup initiatives

5. **What resources are required (program-specific and/or infrastructure)?**
    - Catalogue of capabilities – "the Thomas Register" of do-ables – who can do what
    - Catalogue of grants – searchable, key word glossary
    - Pilot grants $50-100K for "hot ideas" (can we go for a large institutional grant that can get cut up for this)
    - Faculty that can lead large programs
    - Easily approachable research support infrastructure
    - **Enveloping capability to have key MDs (other service line individuals) have grants evolve**
    - **Embedded faculty in others domain – e.g. Engineer in Medicine AIR – Academic in Residence**
    - **Mixing opportunities of clinicians and basic scientists(ACABI is example). Programs, advisors, "buddies," speed science dating, beer mixer**
    - **Challenges – put a grant together – get a bonus/incentive/prize**
    - Expansion of "fab" capabilities at College of Engineering
    - Rapid prototyping/Maker lab
    - **Centralized facility for Omics – particularly Metabolomics i.e. not just genomics, other Omics**
    - **Simplified IRB mechanism for both UA and Banner - integrated**
    - Integrated better general shops for jigs and models – better access, inexpensive, quick turnaround
    - Enhanced materials development
    - Enhance electronics/miniaturization/nano capabilities
    - Enhanced Telecommunication/on Board computing strength
    - Microfluidics
    - Investment in wearable technology bench-strength
    - University-level support for strong or strengthening investigator-level alliances with consumer and medical tech industries.
    - University-level support of major philanthropic development initiative geared at this initiative.
    - University-level support of major branding effort focusing on past accomplishments and future breakthroughs.

6. **What partnerships would help us?**
    - Alliances with universities and specialty labs (e.g. National Labs) that have capabilities that compliment U of A
    - Partnerships with industry – both large and small companies, for enhanced translational capabilities
    - Alliances with industry proponent and advocacy groups
    - Alliances with consumer and market target groups
    - Novel fund raising sources

Breakout Session D

Infectious Disease and Microbiome Science

Michael Worobey and André-Denis Wright

Summary: **Infectious disease** still accounts for a large proportion of all human mortality, and plays an outsize role in the young and in developing countries as well as in resource-limited settings within developed countries. As such, it presents one of the grandest of the challenges facing the world today and one of the biggest opportunities for the University of Arizona to fulfill its mission of making discoveries that improve life locally, regionally, nationally, and globally.

Microbiome research, the study of the complex bacterial and viral communities that have co-evolved to live in and on humans and other animals has the potential to change our understanding of host health and lead to the development of new treatment and prevention strategies. The microbiome has significant effects on many aspects of health and well being, ranging from acute issues like viral infection and gastroenteritis, to more chronic disorders such as inflammatory conditions, colorectal cancer, obesity, and brain function.

Our discussions during the breakout session will be guided by some of the questions below. We have jotted down a few points, but our aim will be to draw on the fuller knowledge of those gathered for the workshop to flesh them out and, perhaps, to add important questions/points missing here.

1. What makes us unique or could make us unique?

UA is unusual in that it is a land grant university and has a medical school (two, actually) and now a veterinary school as well. We have a longstanding culture of collaboration across units. And we have individuals and areas of excellence across a wide range of fields encompassed by infectious disease and microbiome research.

2. What grand challenges are being addressed?

- How can cutting-edge technologies (including ones that we can drive the development of) allow us to more quickly and effectively prevent, control, diagnose, and treat infectious disease? (Or, why does my doctor still not know whether I have a virus or a bacterial infection?)
- What is the real role of the microbiome in health and disease? How can we distinguish interesting correlation from real causation? And how can knowledge about the microbiome be used to improve health outcomes?
- Can we get to a predictive science of the emergence of new infectious diseases?
- How does host biology shape health outcomes in ways that we are missing or incorrectly ascribing to other factors?

3. What new technical capabilities will be developed?

Are there infrastructure/equipment/technology investments that are lacking? What other universities are doing a better job, and how?

What longer-term competitive advantage will be created?
What could be an early demonstration of the new capabilities?
How can these capabilities be extended to other parts of the university?

- **Outsourcing of fast-moving technologies or rental of equipment versus buying**
- **ORD provide a central resource for sequencing info so that researchers can access what resources are available, what are better served off campus (and where)**
- **Need for computational pipeline services**

4. What are specific opportunities for external funding?

There is a recognized need to study these issues using a multi-disciplinary approach; and funding agencies are beginning to recognize this. The director of NIH NIAID recently spoke about the importance of funding these large projects (iCOMOS meeting, Minneapolis 2014) and UC Davis's One Health program was just awarded $100 million grant from USAID to help predict emerging zoonotic diseases. NIH and NSF are obvious sources of funding, but mechanisms such as DoD contracts are perhaps underappreciated at the moment.

- Partnerships with Ventana, sanofi pasteurm Raytheon (faculty embeds, seconondments)

5. What resources are required (program-specific and/or infrastructure)?

Should the university pick a few big investments in these areas? If so, how? Or should we be encouraging success with a larger number of smaller strategic investments (e.g. substantial internal awards in the $100K range that could help generate external funding).

- **Substantial pilot grants to capture bottom-up ideas**
- **Fills need of rapid funding to chase new developments**
- **May address communication issues (who is doing similar work on campus?)**
- **Small collaborative grant fair, simple application**
- **Data and sample repository support**
- **Communication: e.g. who has NIH grants on campus (NIAID is third), internal UA microbiome/ID workshop**
- **Workshops and visiting scientist funding to bring in outside expertise**

5. What partnerships would help us?

Private industry (e.g. sanofi-pasteur, Raytheon)? Other universities (e.g. NIAID Centers for Excellence)? Do we need to corner the market in certain areas to be successful?

7. Other program risks

How do we support the curiosity-driven basic science that has always been the foundation for successful translational research but also encourage translational innovations?

- Need several PIs with R01s to be competitive for Centers and other large funding mechanisms

8. Strategic issues

- Retention of excellent faculty is going to be a challenge in the future.
- Research funding is primarily driven by faculty numbers, so hiring is a key component of this strategy, but may be beyond the purview of the workshop discussion.
- Banner has separate Institutional Review Board from UA. There appear to be red tape barriers to research involving Banner Health