Emerging Technology Division

C-OMICS Translation

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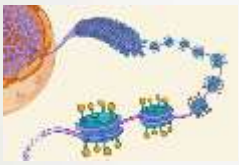
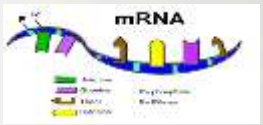
OMICS

Genomics

Proteomics



Epigenomics

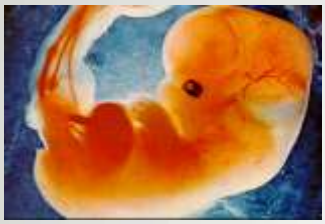


Trascriptomics

Metabolomics

Lipidomics

Clinical Applications in Genomics

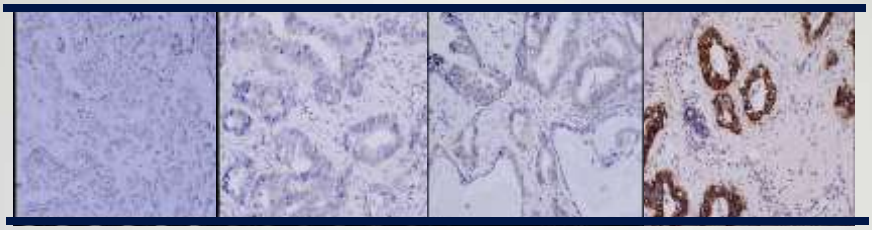


Prenatal:
Non invasive prenatal testing

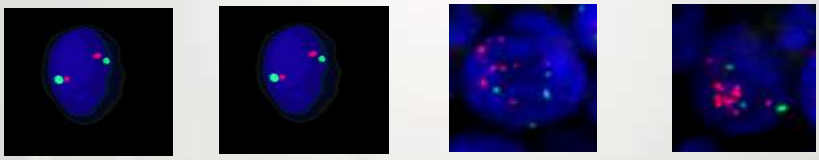
Postnatal:
developmental delay, Multiple congenital abnormalities

Adulthood:
disease onset (cancer, heart disease), Risk (pharmacogenomic, predisposition), fun (ancestry, curiosity)

Clinical Applications of Proteomics: Positive or negative HER2 status



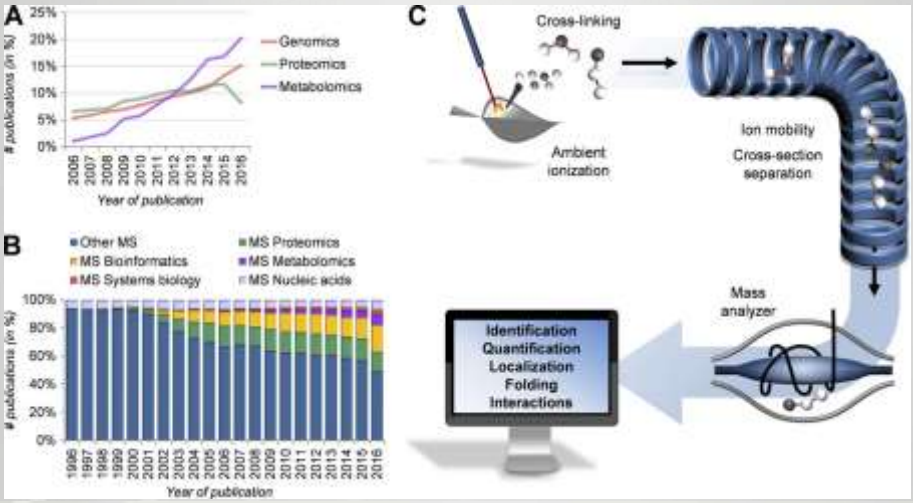
Normal 0 | Normal 1+ | Equivocal 2+ (≤10%) | Abnormal 3+ (>10%)



Normal | Normal | Abnormal low amplification | Abnormal high amplification

- ratio of HER2/neu: CEP17 probes
- ratio ≥ 2 amplification

Proteomics: Mass Spectrometry Past, Present and Future



Simone Sidoli et al. J Cell Biol 2017;216:21-24

JCB

OMICS-Translation

Objectives:

- To assess the diagnostic capabilties and applications of **omic technologies** in different settings,
- To provide educational resources in an easy to digest format,
- To assess need and advocate for omic testing in non-tertiary care settings

OMICS

Differences exist between academic research hospitals, community hospitals and emerging nations:

- Academic research hospitals: ability to sequence germline and acquired abnormalities
  - Whole genome sequencing, whole exome sequencing, large panels, Mass Spec
  - Direct link between detection of clinically significant abnormalities with targeted therapies
- Community hospitals: often either send out testing or limited testing.
- Emerging nations: often under diagnosed, limited therapeutic options

C-OMICS Translation: WG

- Working Group on Implementation of Custom-made Genome Panels
- Working Group on Translation of Single Cell Genomics
- Working Group on Pre-analytical Microvesicle standardization
- Working Group on Volatomics

WG 1: Implementation of Custom-made Genome Panels

Objectives

- To provide practical guidance for implementation of genomic assays
- To extend the link between mutation detection and the availability of targeted therapeutics through advocacy
- To provide links to high quality educational webinars for current practice associated with genomic testing
- Creation of a current awareness webpage
- Education on current state of genomic sequencing and a position paper on current guidelines
- Overcome challenges based on location: differences in access and cost

WG 1: Implementation of Custom-made Genome Panels

Candidate Chair:
Jennifer Morrissette, PhD, FACMG
Associate Professor of Clinical Pathology and Laboratory Medicine
Clinical Director, Center for Personalized Diagnostics
University of Pennsylvania Perelman School of Medicine

WG 1: Implementation of Custom-made Genome Panels

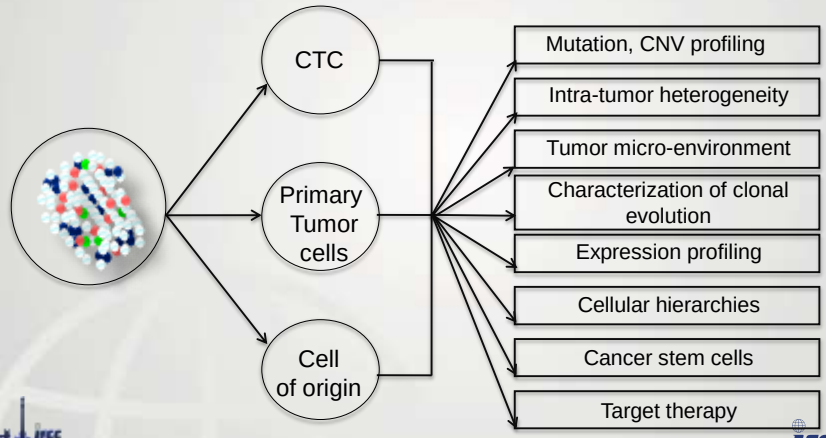
EB genes	Chr. Location	From	To
CD151	11	832902	838835
CDSN	6	31082065	31088252
CHST8	19	34112881	34264414
COL7A1	3	48601506	48632593
COL17A1	10	105791046	105845638
DSP	6	7541870	7589946
DST	6	56322785	56819426
EXPH5	11	108076150	108464465
FERMT1	20	6055492	6104191
ITGA3	17	45133340	45167849
ITGA6	2	173292314	173371181
ITGB4	17	73717516	73753899
JUP	17	39910859	39942984
KRT5	12	52666359	52914243
KRT14	17	39738531	39743147
LAMA3	18	21268407	21370117
LAMB3	1	209788218	209825820
LAMC2	1	183155174	183214262
PKP1	1	201252580	201302121
PLEC1	8	144989321	145035044
TGM5	15	43524793	43559055

Chr	nt Location	Ref	Variant	Gene	AA Change	Variant Frequency
4	55141055	A	G	PDGFRA	synonymous	99 %

FDA-approved drugs
KRAS G12D sensitive to Sorafenib

WG 2: Translation of Single Cell Genomics

Why Single Cells?



WG 2: Translation of Single Cell Genomics

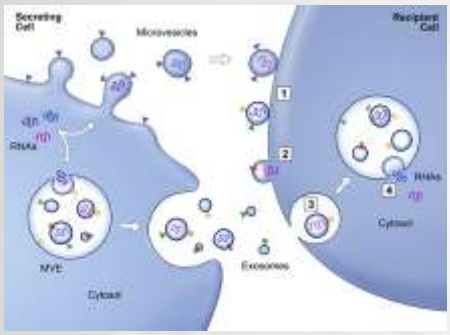
- Identify and characterize rare cell types
- Analyze and understand cellular heterogeneity and how this contributes to our biological system
- Perform cellular phenotyping with single cell RNA-seq to identify novel targets, biomarkers, and cell types and states without the need for pre-selected targets
- Evaluate mRNA and cell surface protein expression profiles within the same cell
- Perform high throughput and high resolution functional genetic screens in tens of thousands of cells simultaneously
- Assess comprehensive gene expression phenotypes for individual CRISPR perturbations

Advancing excellence in laboratory medicine for better healthcare worldwide

WG 2: Translation of Single Cell Genomics

Candidate Chair:
Eric Londin, PhD
Associate Professor
Department of Clinical Pathology and Laboratory Medicine
Computational Medicine Center
Thomas Jefferson University

WG 3: Pre-Analytical Microvesicle Standardization



- Exosomes are cell-derived vesicles that contain protein, lipids and nucleic acid
- Different RNA species (miRNA, mRNA, tRNA, piRNA, snRNA) are more abundant in specific fluids
- They are present in several body fluids including serum, plasma, urine and CSF

WG 3: Pre-analytical Microvesicle Standardization

- Exosomes are used as biomarkers for brain cancer and neurodegenerative disease
- Exosomes are non-immunogenic
- Exosomes are potential tool to deliver therapeutic molecules
  - Limitations: large-scale production, successful loading with therapeutic cargo, targeting to specific tissue/organ and efficient release of the cargo
- Growing number of companies are improving exosome isolation encouraging the use of NGS approach in exosome characterization

WG: Pre-Analytical Microvesicle Standardization

- Standardization of purified subset of microvesicle is in progress in USA and EU
- Major limitation is the time consuming procedure to be applied to purify vesicle (endosomal origin same composition as plasma membrane therefore we find biomarkers for therapy and diagnosis)
- This will allow liquid biopsy compared to solid tumor biopsy. Microvesiscle Exosome and Oncosome and Exomere

WG 4: Volatomics

- Breath analysis is not new.
- Existing applications - breath alcohol testing, hydrogen, carbon monoxide, oxygen, carbon dioxide, nitric oxide, and nitrous oxide testing.
- Advantages: non-invasive and easily obtained specimen.
- Diagnostic prospect is utility in the pattern of volatile organic compounds (VOCs) in breath.
- Breath analysis technologies are diverse - *e.g.*, mass spectrometry, sensors and sensor arrays, gas chromatography.
- Trends include the use of artificial intelligence, cloud-based analysis of data and analyzers that link to a smartphone.

Volatomics (I)

Objectives:

A web page on the IFCC site that will provide a regularly updated perspective on the emerging clinical diagnostic applications of volatolomics over the next 3 years.

Content will include:

1. News items and opinion pieces from key researchers/opinion leaders about recent developments in the clinical diagnostic applications of volatolomics.

2. A directory of companies active in the clinical diagnostic applications of volatomics.

Volatomics (II)

3. Links to clinical trials involving volatomic testing.

4. Details of analyzers and regulatory approvals of clinical diagnostic products based on volatomic testing.

5. A literature survey updated quarterly designed to provide an educational resource and a snapshot of work since 2010.

WG: Volatomics (breath analysis, breathomics)

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University of Pennsylvania Perelman School of Medicine

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IFCC GENERAL CONFERENCE
Advancing excellence in laboratory medicine for better healthcare worldwide
ifcc International Federation of Clinical Chemistry and Laboratory Medicine

Conclusions

1. Creation of a current awareness webpage
2. Education on current state of OMICS *e.g.*, genomic sequencing and a position paper on current guidelines
3. Overcome challenges based on location: differences in access and cost
    1. Opinion on best practices for emerging nations to move into genomics
    2. Advocacy for implementation in emerging nations: Proof-of-principle
4. Interaction with industry and pharmaceutical partners
5. Invite people to apply to join or contribute

C-OMIC TRANSLATION

C-OMICS Translation: Terms of Reference

- To highlight the current state of omics technology that might become available for routine diagnosis and monitoring in the future.
- To review omics technology guidelines and position papers in conjunction with other professional organizations.
- To provide guidance for complex multi-analyte omics testing including data integration and interpretation.
- To provide guidance on pre-analytical factors for omics applications including consideration of sample matrices
- To provide assessment of emerging volatomics technologies and their impact on the diagnosis, management and understanding of human diseases.
- To establish collaborations and partnerships with the other organizations and stakeholders concerned with omics.
- To lead and promote education activities that support appropriate translation and use of omics.