KLİMİK 2016

30.YIL KURULTAYI

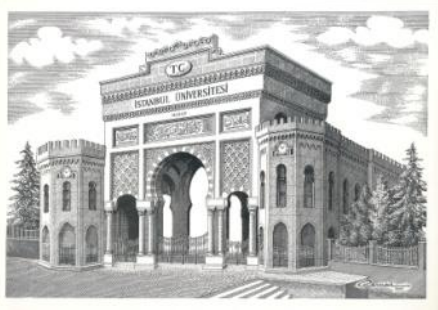
Mikrobiyolojide Son Gelişmeler

Moleküler Tanı Testlerinde Gelişmeler

Mert A. Kuşkucu PhD

İ.Ü. Cerrahpaşa Tıp Fakültesi

Tıbbi Mikrobiyoloji Anabilim Dalı

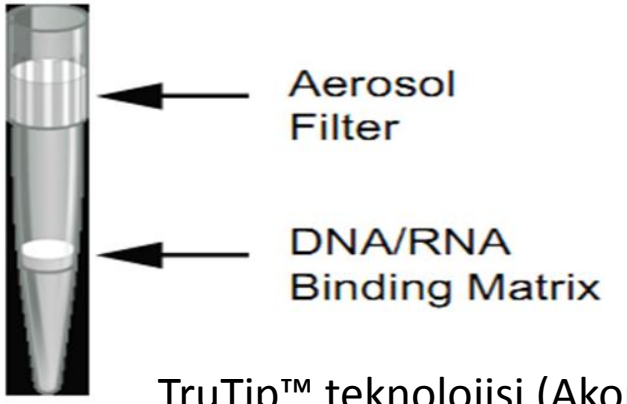


Moleküler Testler = Vazgeçilmez Alet Kutusu

- **Nükleik Asit Tabanlı Testler;**
  - **Nükleik Asit Eldesi + Amplifikasyon**
  - **Minyatürizasyon; ‘’Stand-Alone’’ sistemler; “Point of Care” Teknolojileri**
- **DNA Dizi Analiz Yöntemleri**
- **Kütle Spektrofotometresi**
- **“Phage Display”**
- **Değişen Tanı Yaklaşımı**

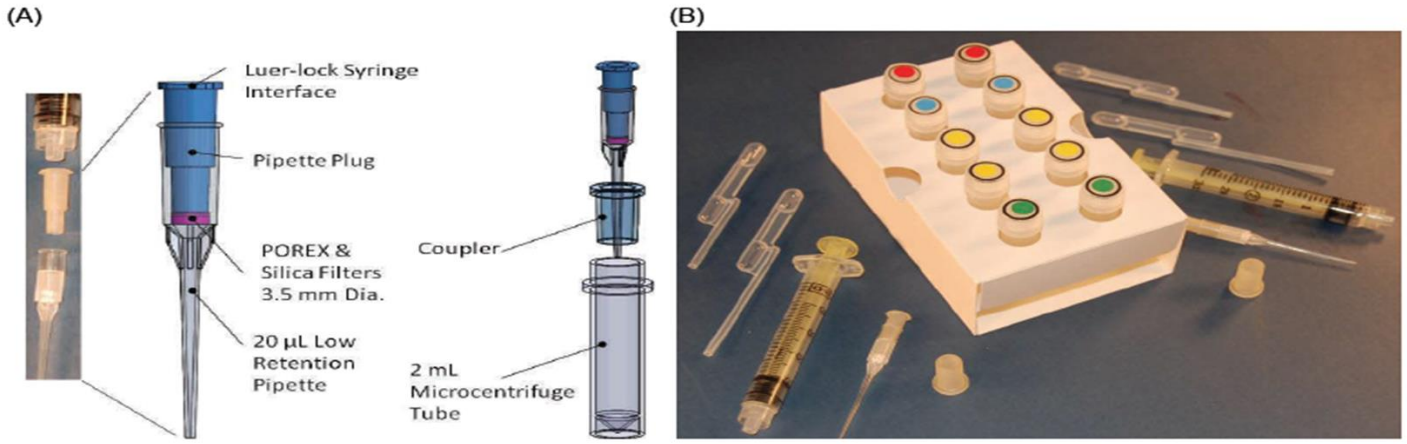
Nükleik Asit Eldesi

- Mekanik parçalama
- Isı ile yıkım
- Kimyasal parçalama
- Enzimatik yıkım
- Proteinleri bağlayan rezinler...



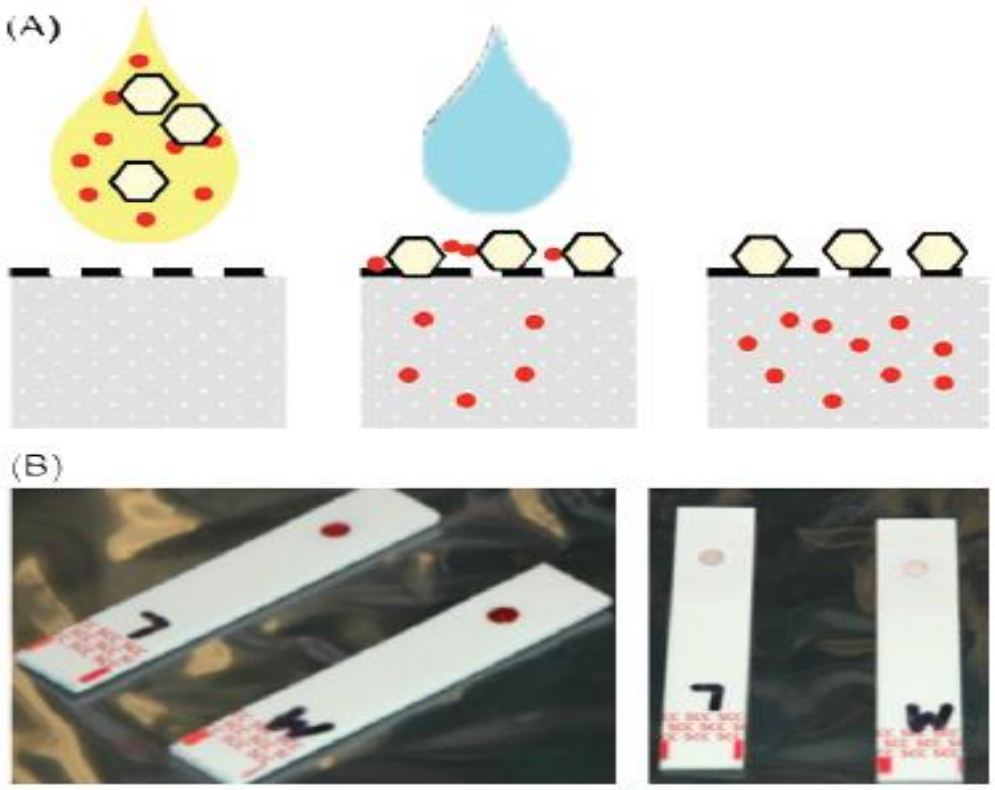
TruTip™ teknolojisi (Akonni)

Simple nucleic acid processing (SNAP)
Blood Cell Storage Inc. (BCSI, Seattle WA)



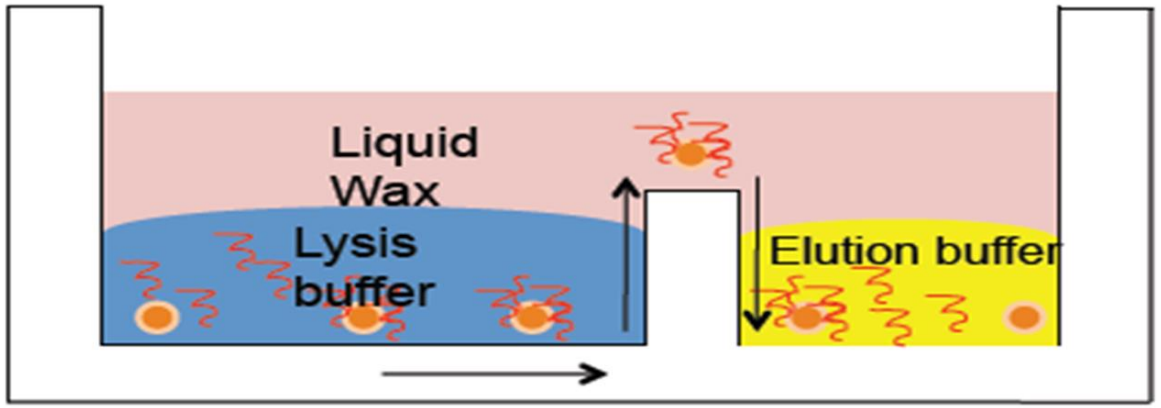
Program for Appropriate Technologies in Health (PATH)

Nükleik Asit Eldesi



Pro-viral DNA Capture Card (PDCC)

Birbirleri ile Karışmayan Sıvı Teknolojisi



Northwestern University -- Quidel

Yıkama sıvısı gerektirmez!!!!!

Amplifikasyon Yöntemleri

Döngüsel Isı Profili Kullananlar

PCR
Real Time PCR

İzotermal Yöntemler

LAMP
RPA
RCA
Helikaz Depended Amplifikasyon
LCR
.
.
.

Polimeraz Zincir Reaksiyonu

The Wittwer Lab for DNA Analysis
dna.utah.edu

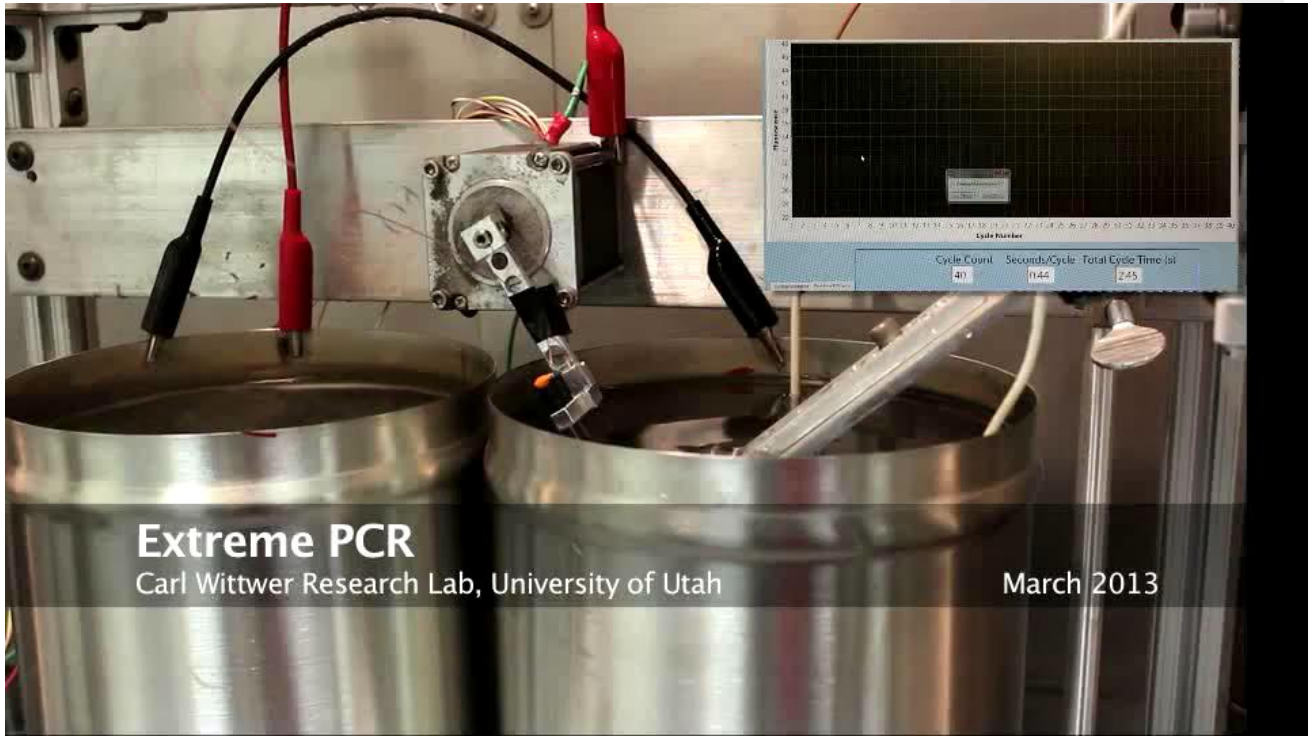
Home | Publications | About Carl | About the Lab | Contact Us | Log In

Search this site

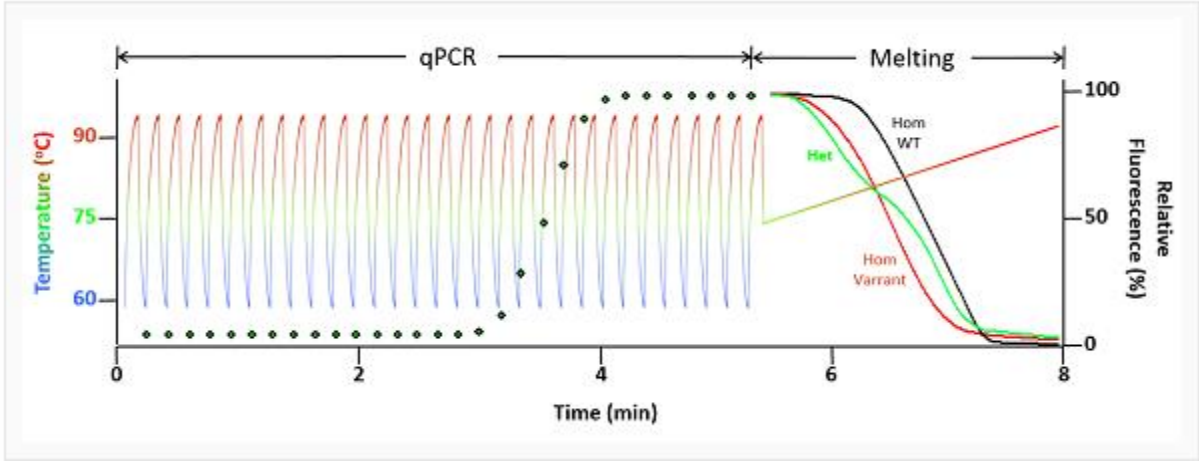
What we do
Rapid-cycle PCR

Extreme PCR

Efficient and Specific DNA Amplification in 15-60 Seconds



PCR kullanılan enzim miktarı ve primer miktarı rutin testlerde kullanılan miktarın 10-20 kat fazlası
Kapiler tüpte reaksiyon gerçekleştirilir



https://dna.utah.edu/tables/speed_of_pcr.php

Speed of PCR Research Publications

Show 100 entries

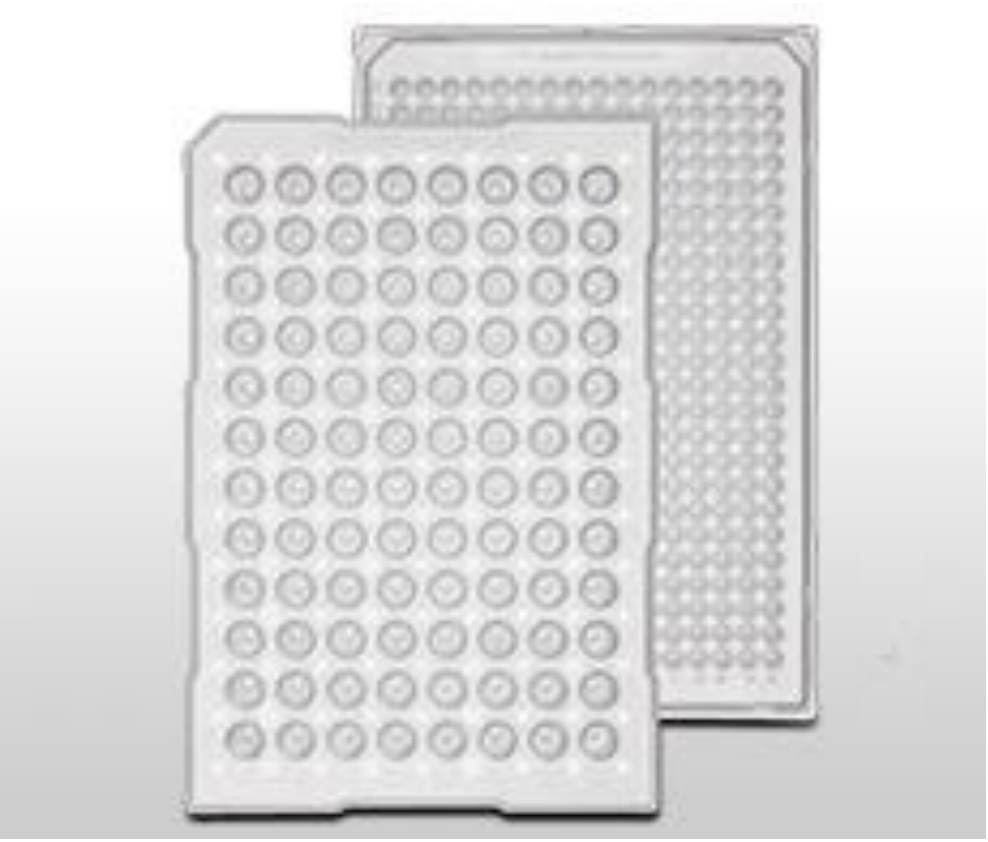
Search:

Fastest Cycle Time (s)	[Template] (copies/µL)	Template	Total [Primers] (nM)	Polymerase (U/µL)	[Polymerase] (nM)	Product Length (bp)	Method	No Template Control?	Yield	Comment	Year	Author
12	40,000	Lambda phage	400	0.2U/ul Taq	7.5	500	IR Heating, Pressurized Air Cooling	No	Capillary Electrophoresis	?	2001	Giordano et al.
12	1,000,000	230 bp PCR product	1000	0.5 U/ul Taq	19	230	Continuous Flow	Yes	Good gel band	Dependent on cycle# and copy #	2003	Obeid et al.
2.6	?	stx phage (E. coli)	?	0.5 U/ul Taq	19	85	Pressuried gas and capillaries	No	Very dim band	2.6 s cycles	2004	Whitney
2.7	?	stx phage (E. coli)	?	KOD	?	85	Gallium transfer from Peltiers to capillaries	No	Barely visible band	Decreasing yield from 3.06 s to 2.69 s cycles	2010	Maltezos et al.
20	1,600	Human DNA	1000	0.08 U/ul Taq	3	536	Capillary Air Cycling	No	Faint Gel Band	Increases w/ [Polymerase]	1990	Wittwer et al.
3.0	10,000	Plasmids (B. anthracis)	1200	0.05 U/ul Ex Taq HS	?	134	Constant flow with vapor pressure	Yes (5% signal)	15% of control	80% at 7.5 s cycles	2011	Fuchiwaki et al.
4.2	50	B. subtilis (bacterial DNA)	?	KOD plus	?	72	IR laser	?	Cq= 33 (SYBR)	Higher copy # reduces Cq	2008	Terazono et al.
4.6	34,000	E. herbicola (bacterial DNA)	800	0.04 U/ul KAPA2G	4	58 / 160	Water pumped through porous copper	No	Faint gel bands	Yield increases with # cycles	2004	Wheeler et al.
5.2 / 9.7	180,000,000	Lambda phage	400	0.07 U/ul Taq	2.6	500 / 997	Continuous Flow	No	Faint gel bands	Dependent on cycle times	2004	Hashimoto et al.
5.25	1,400,000	B. subtilis (bacterial DNA)	500	0.025 U/ul KOD plus	?	72	Water pumped against aluminum plate	Yes	90% efficiency (SYBR)	Single run	2010	Terazona et al.
6.3	10,000	Plasmids (B. anthracis)	1200	0.05 U/ul Ex Taq HS	?	134	Plug Continuous Flow	Yes	55% of control	?	2011	Fuchikwaki et al.
7	10,000,000	1 KB PCR product	2000	0.25 U/ul Taq	9.4	176	Continuous Flow	Yes	7% of control	50% at 15s cycles	1998	Kopp et al.
8.5	?	cDNA	1800	?	?	82	Micromachined cantilever	?	80% efficiency	Decreasing efficiency at faster cycles	2006	Neuzil et al.
9	18,000,000	Lamba phage	2000	0.025 U/ul Taq	0.94	500	Continuous Flow with a Ferrous Particle Plug	No	OK gel band	Intensity increases with cycle time	2007	Sun et al.
9.25	4,700 - 470,000	18S rDNA (human genomic)	1800	Taq Gold	?	187	IR Heating of droplets in oil	No	?	?	2009	Kim et al.

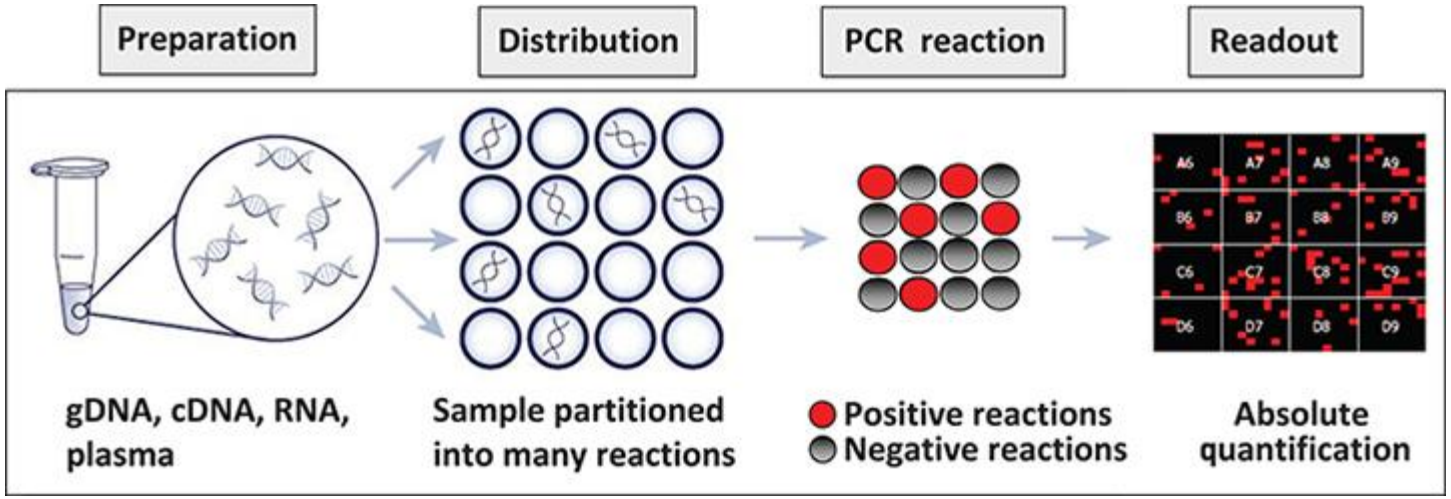
Showing 1 to 15 of 15 entries

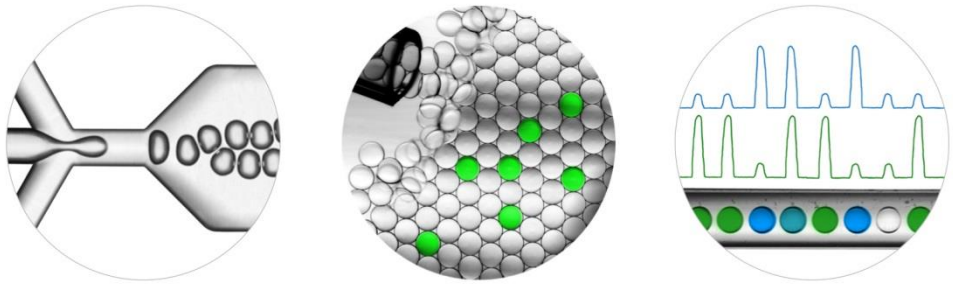
Previous 1 Next

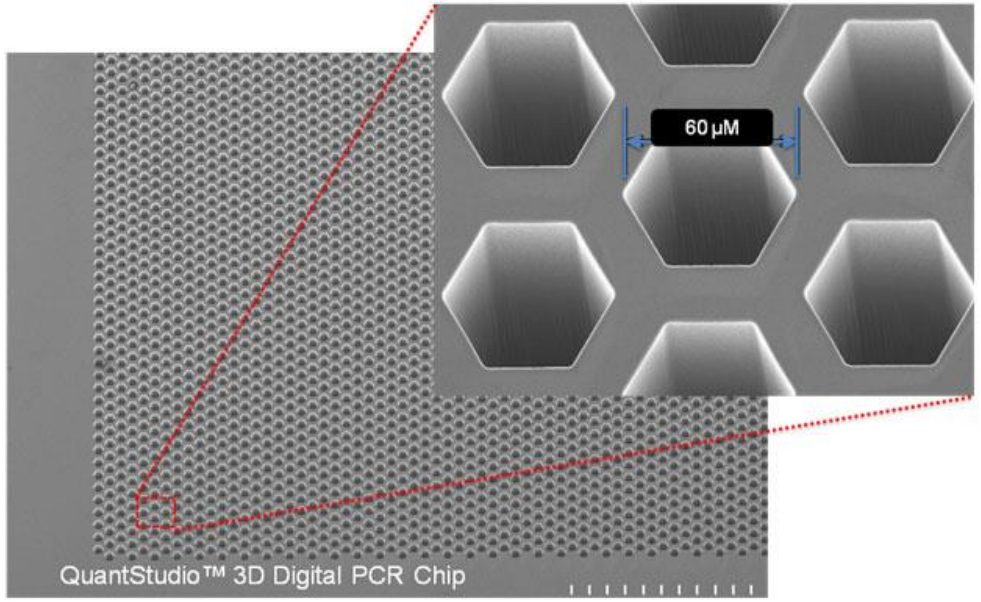
Real Time PCR; Çoklu PCR; Digital PCR



Digital PCR


Preparation
Distribution
PCR reaction
Readout
gDNA, cDNA, RNA, plasma
Sample partitioned into many reactions
Positive reactions
Negative reactions
Absolute quantification




60 µM
QuantStudio™ 3D Digital PCR Chip

Assays	Samples
12	384
24	216
36	144
48	108
54	96
72	72
80	64
96	54
120	42
144	36
216	24
248	20
296	16
384	12

Many Flexible Configurations

With many different preprogrammed dispense configurations on the MSND printing your assays in your lab has never been easier. Print in your lab in about 30 minutes and begin your experiments today, no need to wait.

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Design your own plate, building from inventoried, pre-designed, and custom TaqMan® Gene expression assays. Minimum order quantity is dependent upon OpenArray® format.

Select your array format:

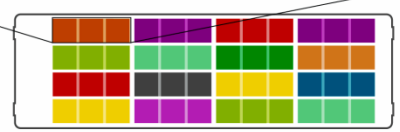
Format	Number of Assays	Number of Samples	Minimum Order Qty		
18	18	48	1 (10 pack)	View Layout	Select
56	56	48	1 (10 pack)	View Layout	Select
112	112	24	2 (10 pack)	View Layout	Select
168	168	16	3 (10 pack)	View Layout	Select
224	224	12	4 (10 pack)	View Layout	Select

FOR GT CUSTOM 192

	1	2	3	4	5	6	7	8
a	1	2	3	4	5	6	7	8
b	25	26	27	28	29	30	31	32
c	49	50	51	52	53	54	55	56
d	73	74	75	76	77	78	79	80
e	97	98	99	100	101	102	103	104
f	121	122	123	124	125	126	127	128
g	145	146	147	148	149	150	151	152
h	169	170	171	172	173	174	175	176

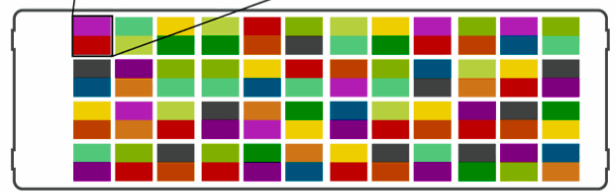
	1	2	3	4	5	6	7	8
a	9	10	11	12	13	14	15	16
b	33	34	35	36	37	38	39	40
c	57	58	59	60	61	62	63	64
d	81	82	83	84	85	86	87	88
e	105	106	107	108	109	110	111	112
f	129	130	131	132	133	134	135	136
g	153	154	155	156	157	158	159	160
h	177	178	179	180	181	182	183	184

	1	2	3	4	5	6	7	8
a	17	18	19	20	21	22	23	24
b	41	42	43	44	45	46	47	48
c	65	66	67	68	69	70	71	72
d	89	90	91	92	93	94	95	96
e	113	114	115	116	117	118	119	120
f	137	138	139	140	141	142	143	144
g	161	162	163	164	165	166	167	168
h	185	186	187	188	189	190	191	192



FOR GT CUSTOM 32

	1	2	3	4	5	6	7	8
a	1	2	3	4	5	6	7	8
b	9	10	11	12	13	14	15	16
c	17	18	19	20	21	22	23	24
d	25	26	27	28	29	30	31	32
e	1	2	3	4	5	6	7	8
f	9	10	11	12	13	14	15	16
g	17	18	19	20	21	22	23	24
h	25	26	27	28	29	30	31	32



nature methods
Techniques for life scientists and chemists

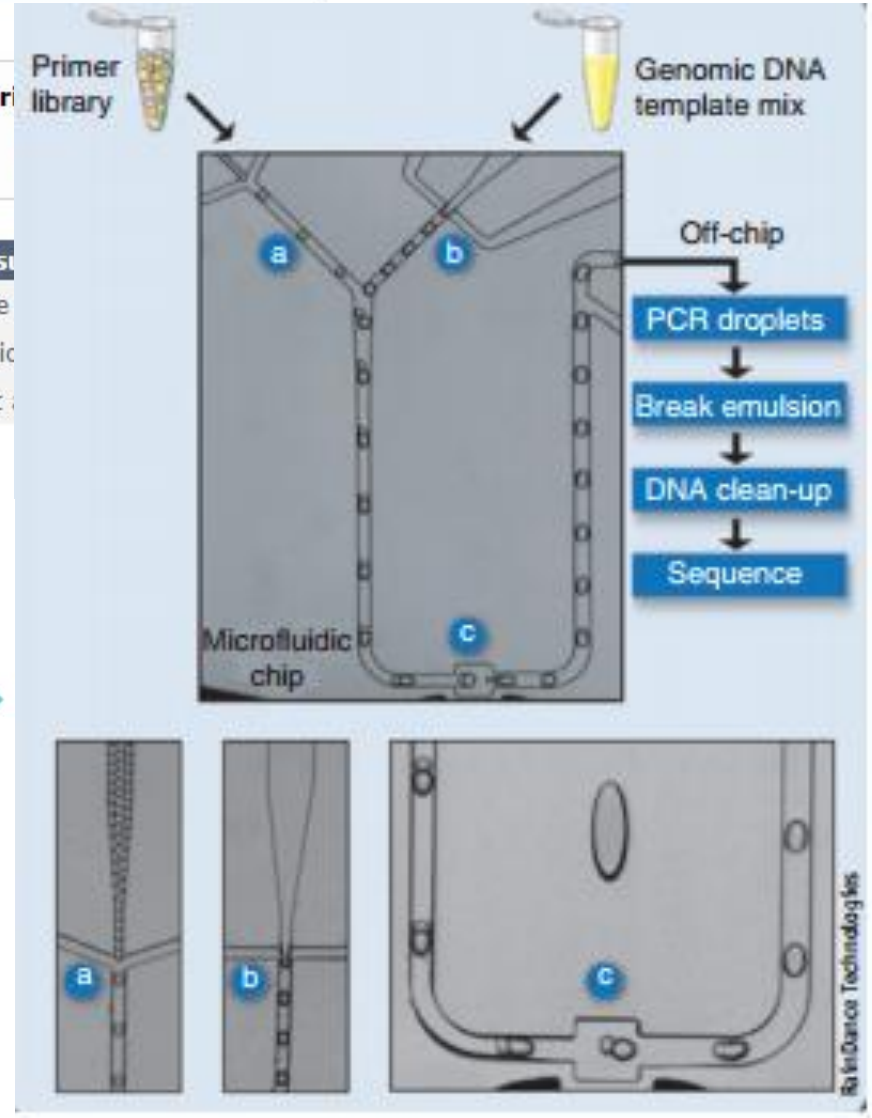
TECHNOLOGY FEATURE

Nature Methods **7**, 351 - 356 (2010)
doi:10.1038/nmeth0510-351

Clever PCR: more genotyping, smaller volumes

Monya Baker[1]

With microfluidics and multiplexing, researchers can get more information from PCR products in less time and with fewer reagents.



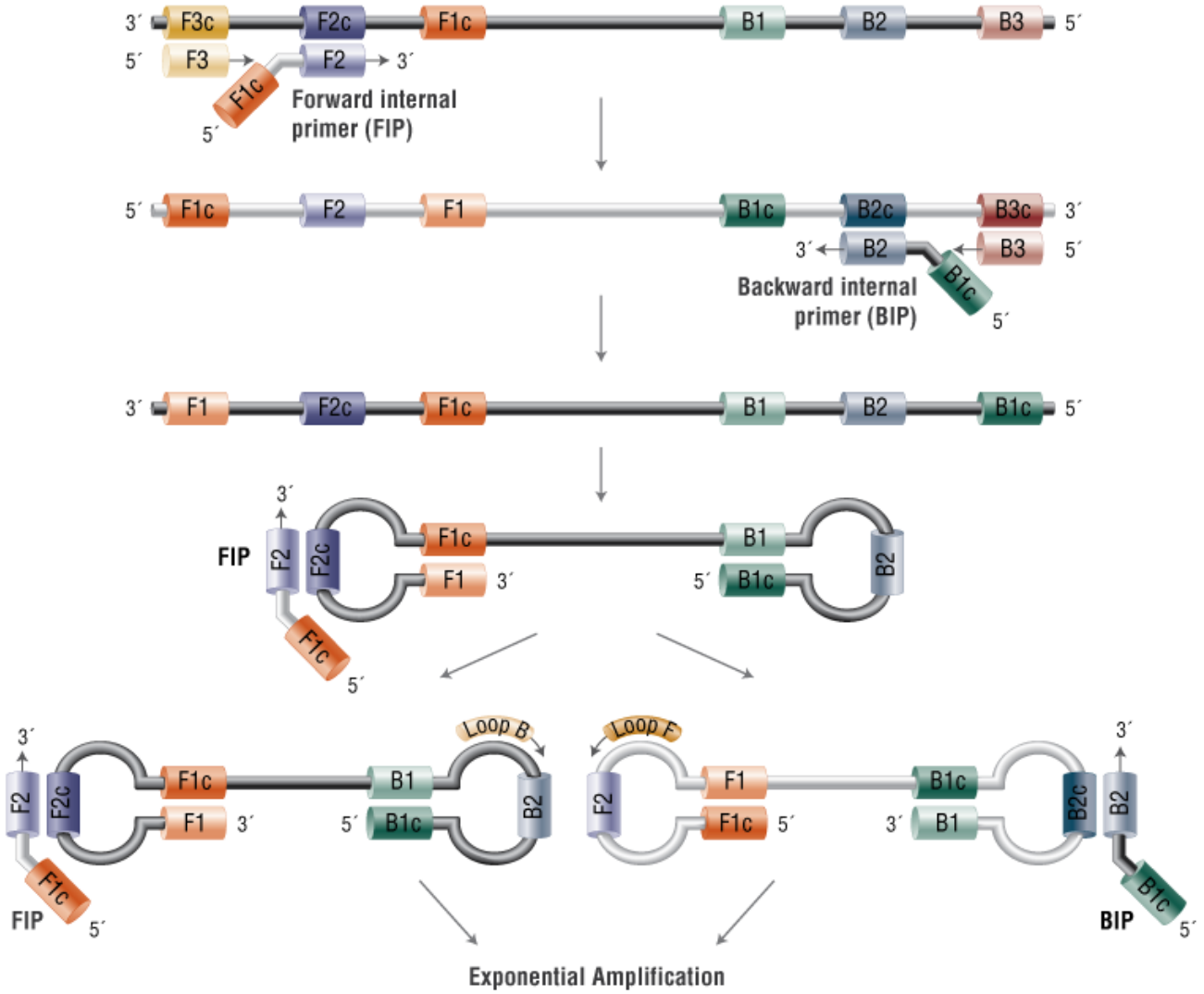
RainDance creates tiny droplets as vessels for PCR amplification.

İzotermal Yöntemler

- LAMP
- TMA, NASBA
- RPA
- RCA
- Helikaz Depended

Amplifikasyon

- LCR
- .
- .
- .

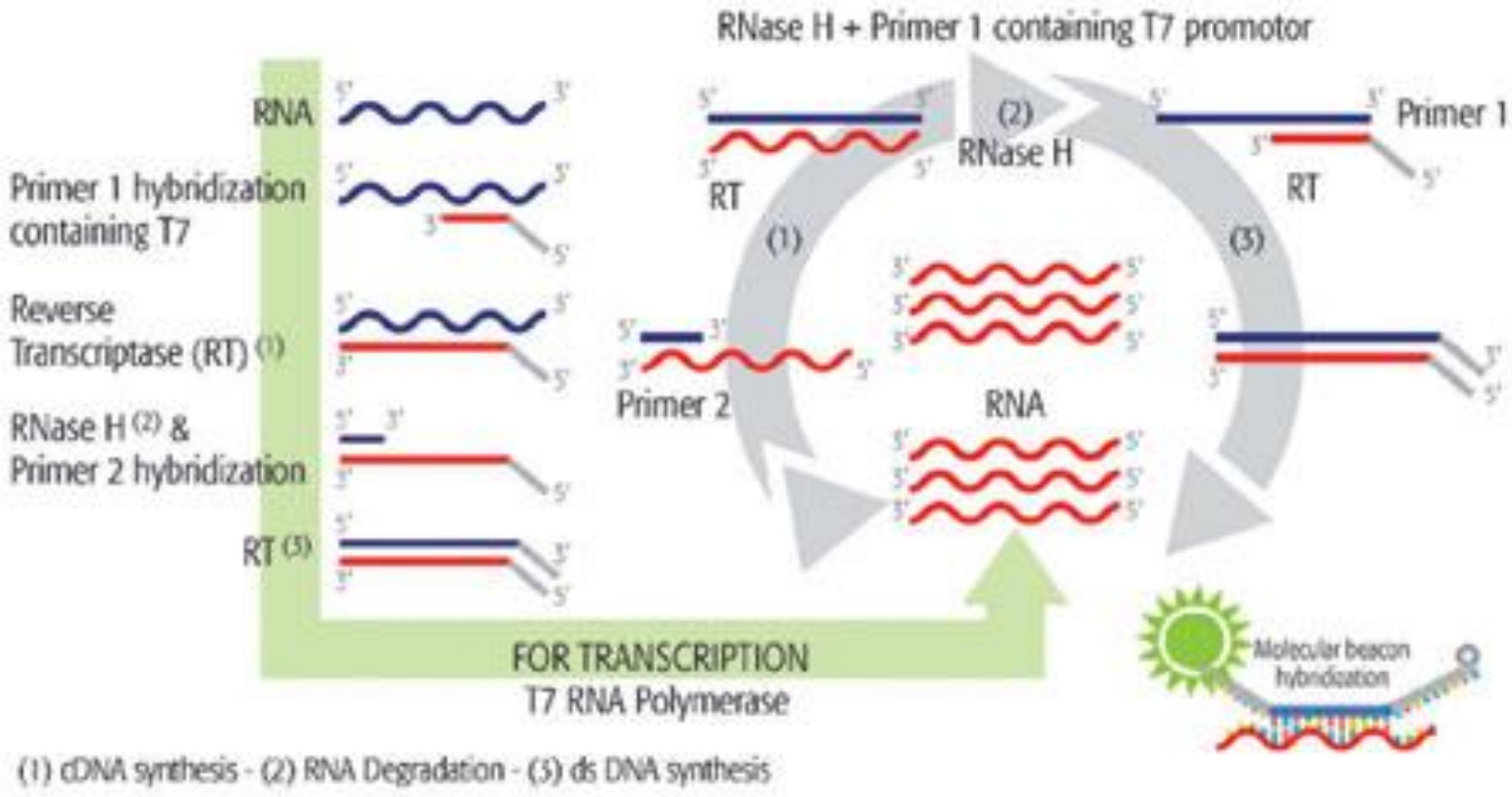


İzotermal Yöntemler

- LAMP
- TMA, NASBA
- RPA
- RCA
- Helikaz Depended

Amplifikasyon

- LCR
- .
- .
- .

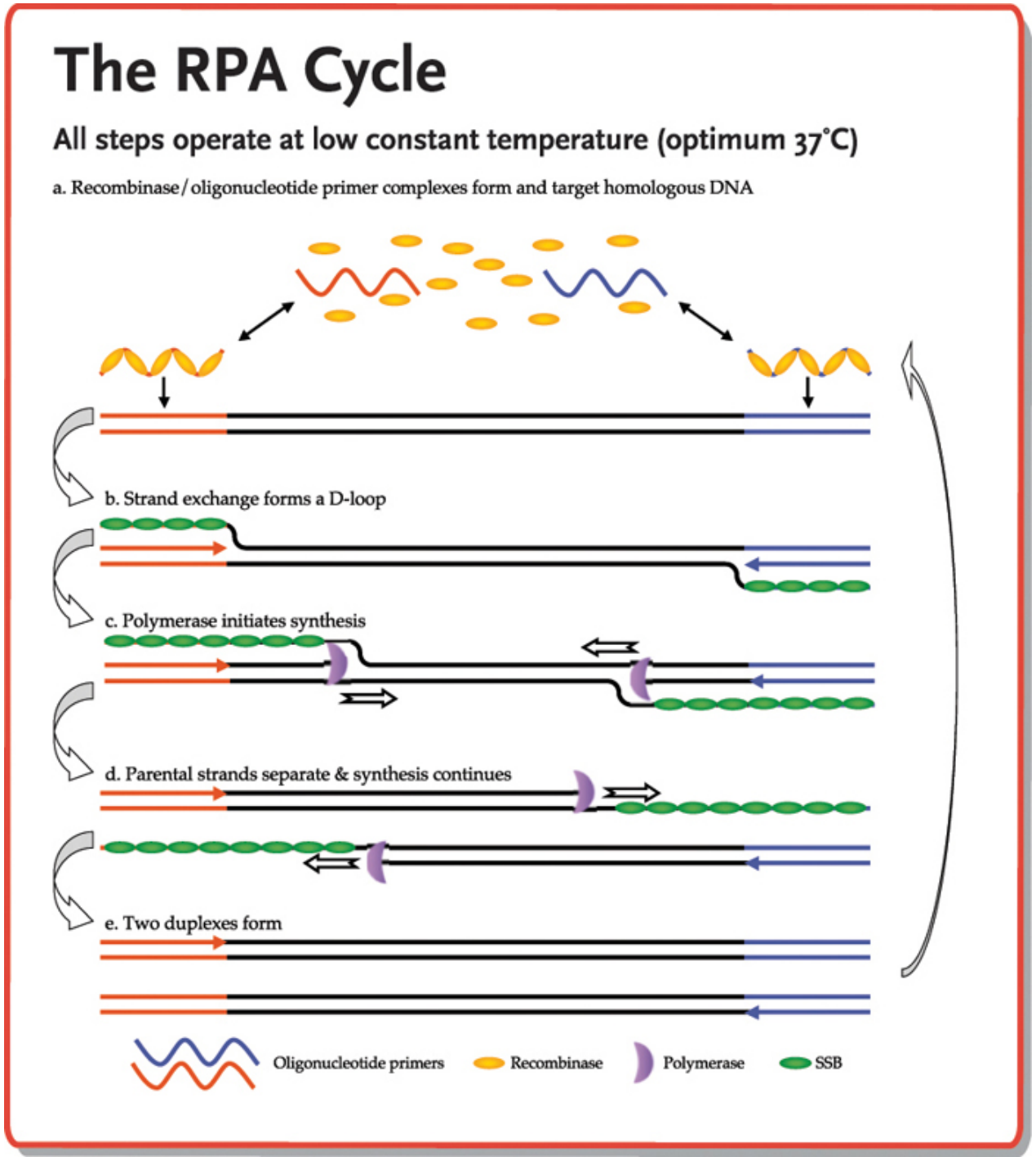


İzotermal Yöntemler

- LAMP
- TMA, NASBA
- RPA
- RCA
- Helikaz Depended

Amplifikasyon

- LCR
- .
- .
- .

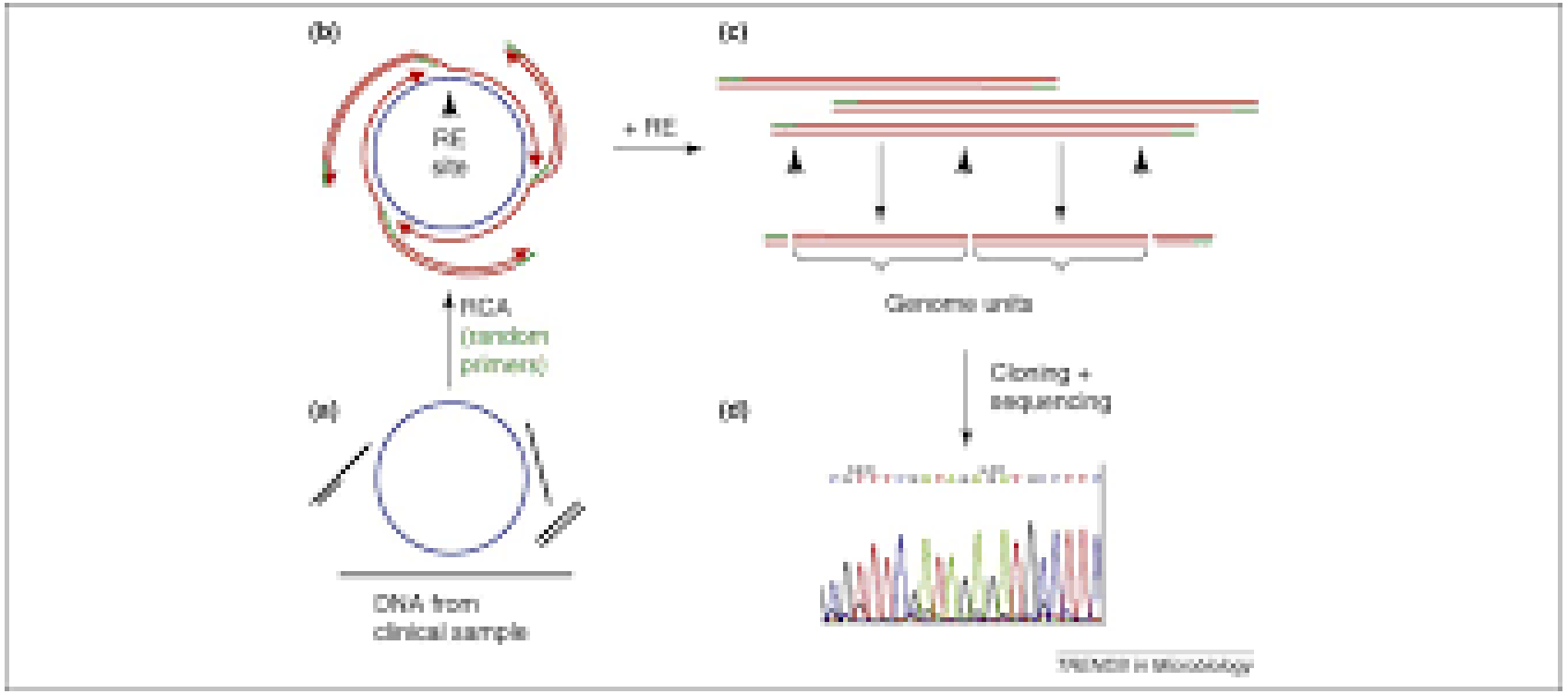


İzotermal Yöntemler

- LAMP
- TMA, NASBA
- RPA
- RCA
- Helikaz Depended

Amplifikasyon

- LCR
- .
- .
- .



Amplifikasyon Yöntemleri

Döngüsel Isı Profili Kullananlar

PCR
Real Time PCR

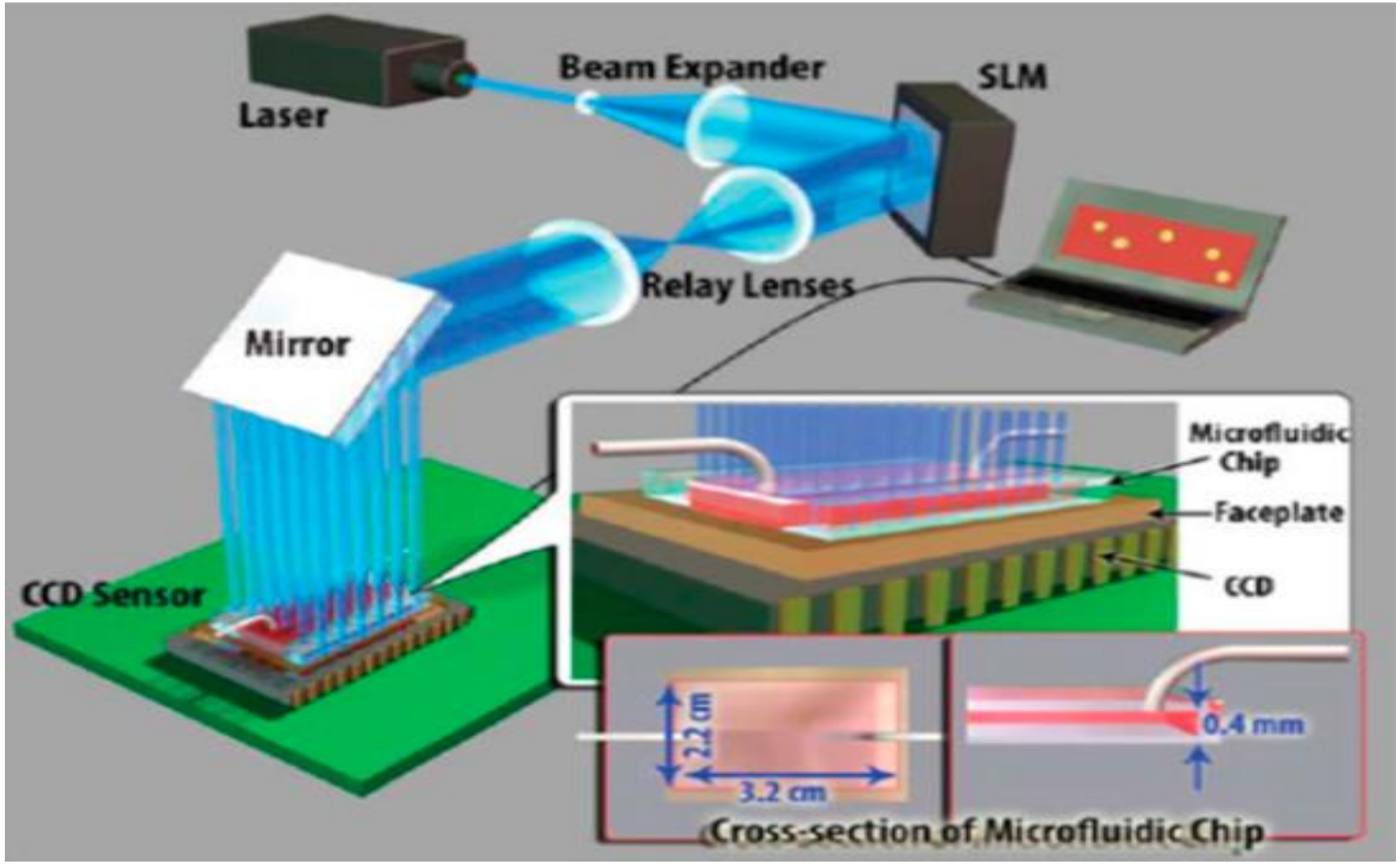
İzotermal Yöntemler

LAMP
RPA
RCA
Helikaz Depended Amplifikasyon
LCR
.
.
.

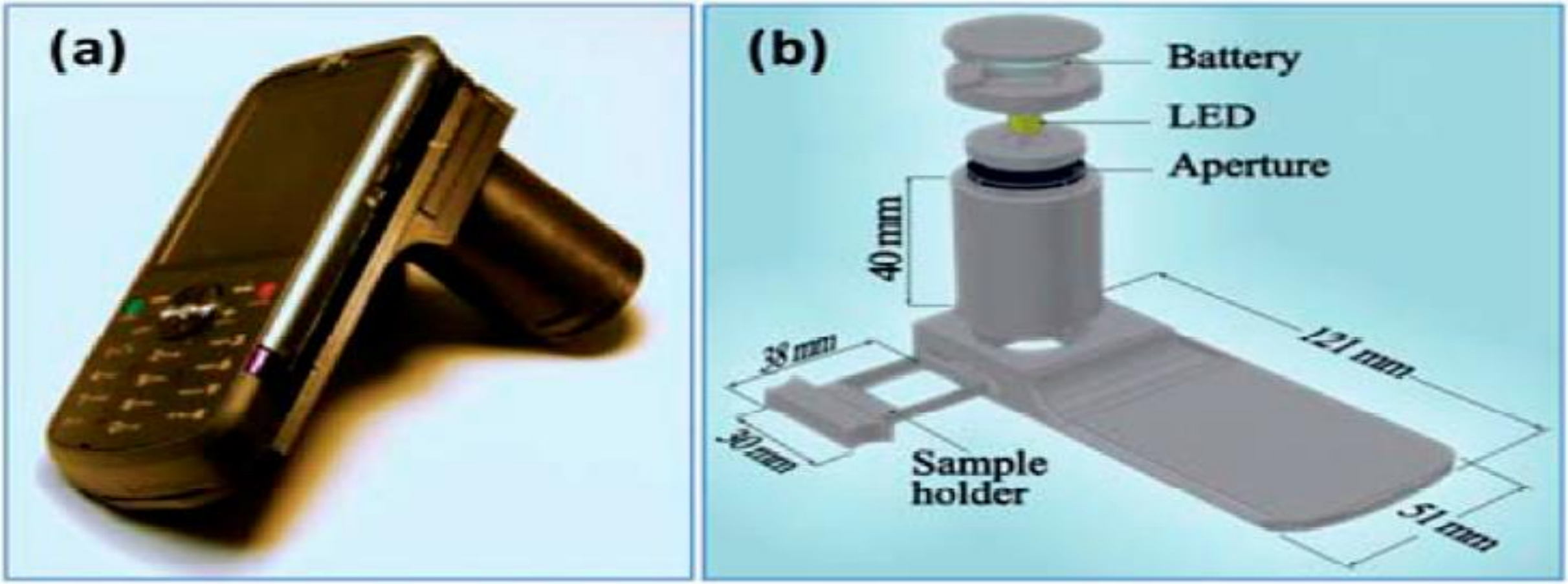
Saptama, Sensörler

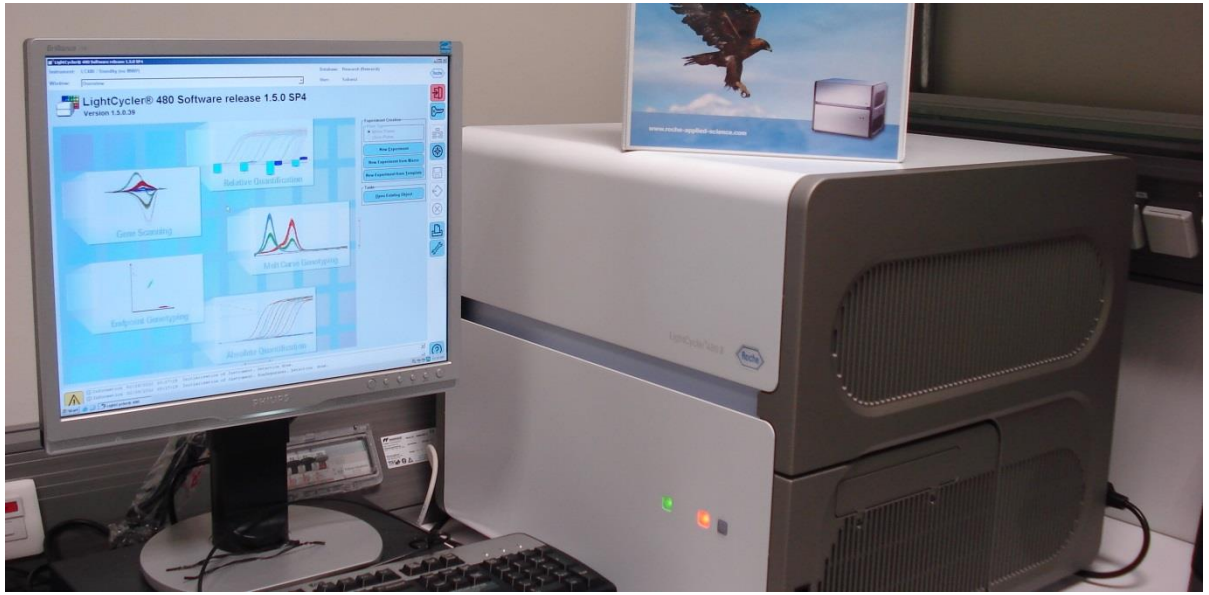
Fluorescence based real-time detection
Electrophoresis
Lateral Flow
DNA hybridization microarray
Electrochemical method

Saptama, Optik Sensörler



Saptama, Optik Sensörler





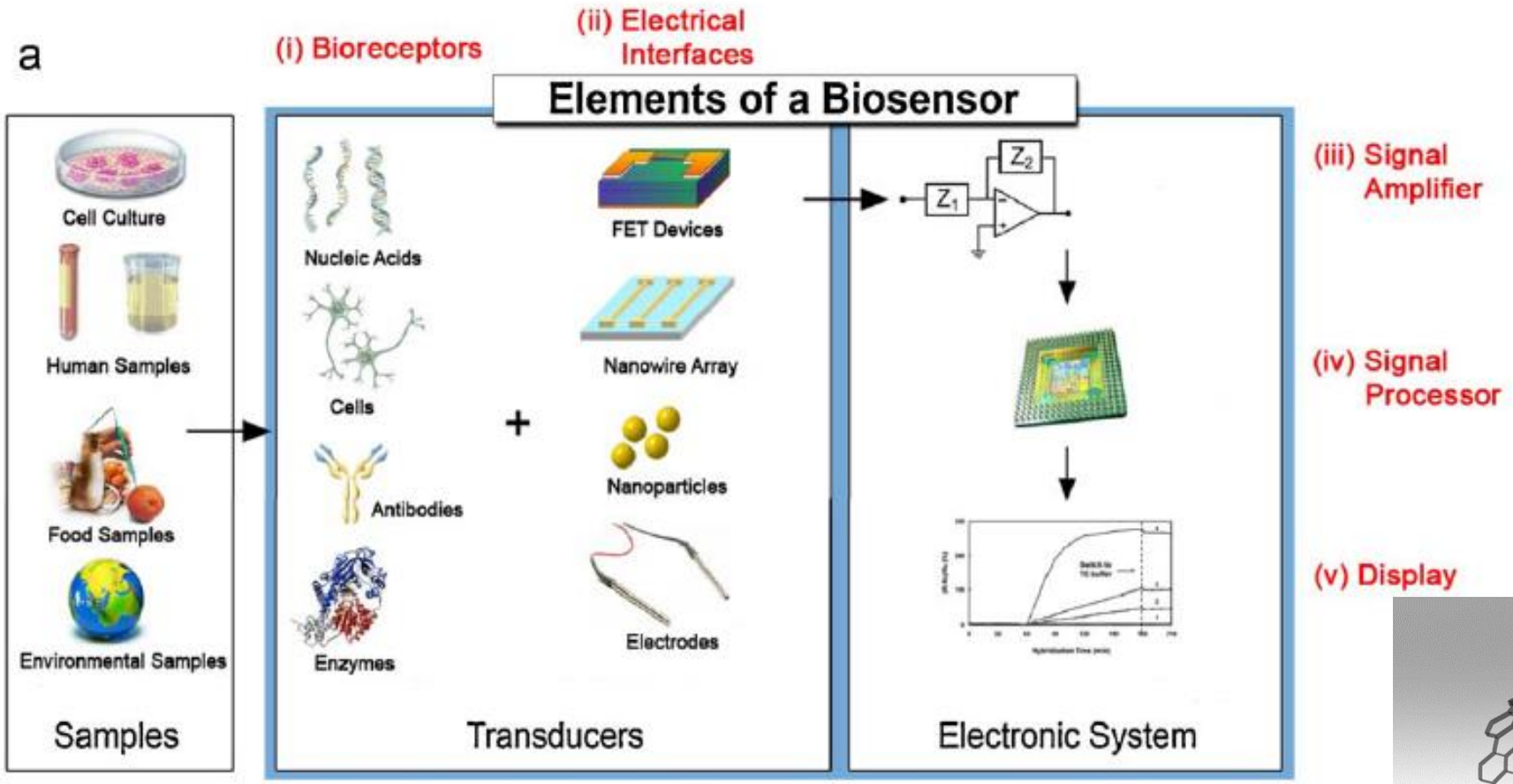
Monochrome CCD camera
1024 x 1344 pixels =**1,3 Megapiksel**

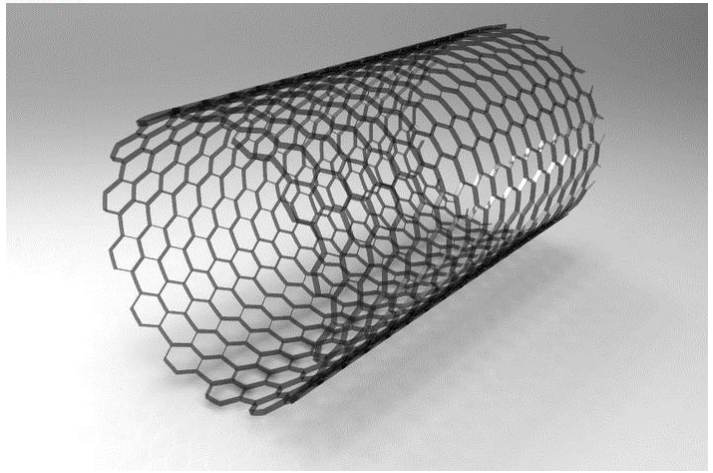
12 Megapiksel

16 Megapiksel

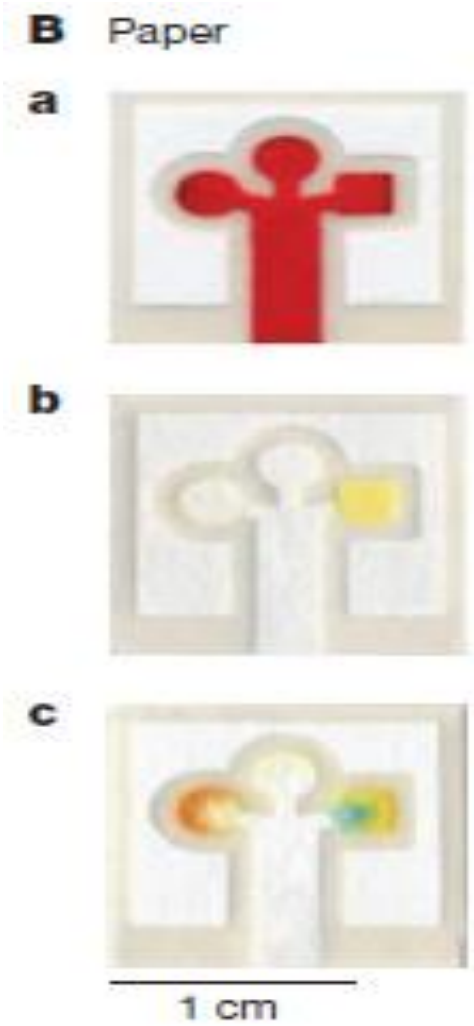
13 Megapiksel

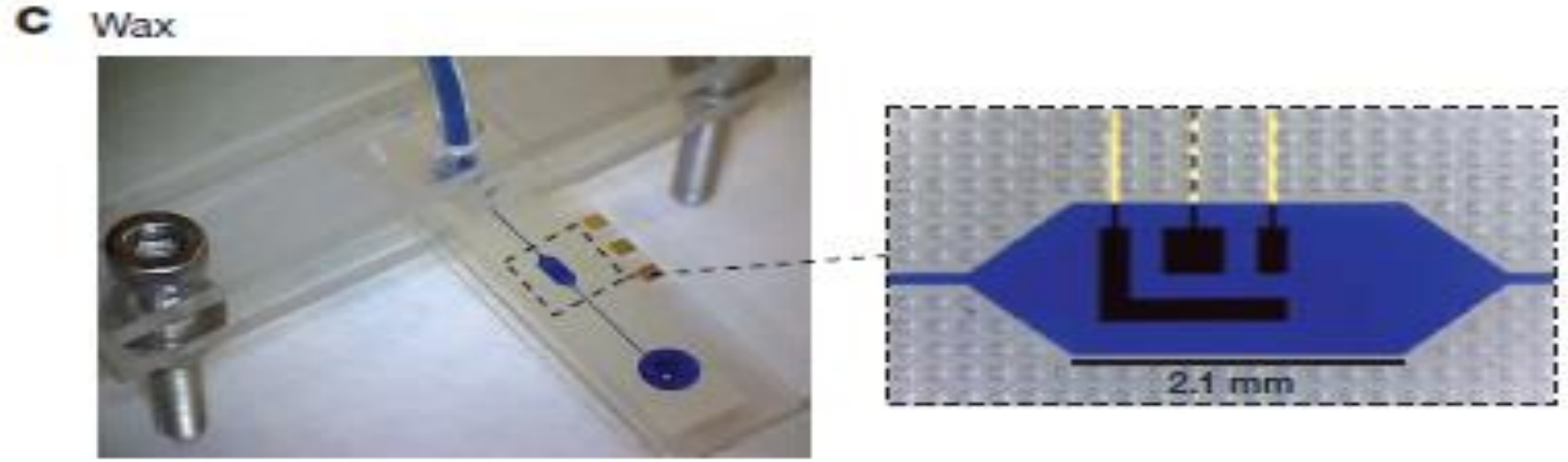
Saptama, Elektirik Alan Algılama





Kağıt Tabanlı Testler

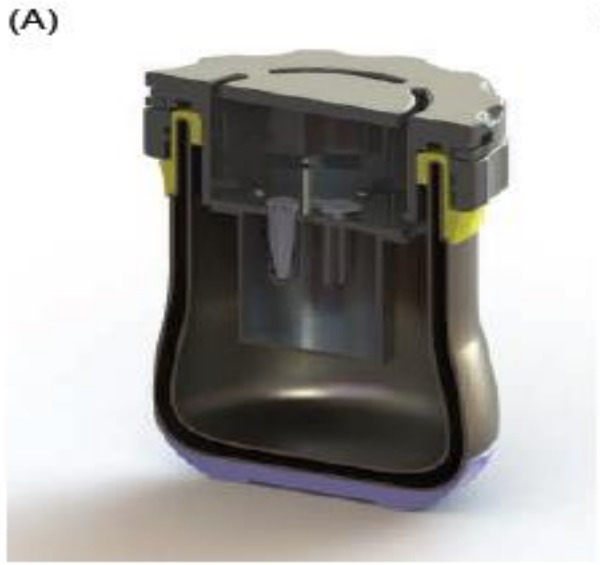


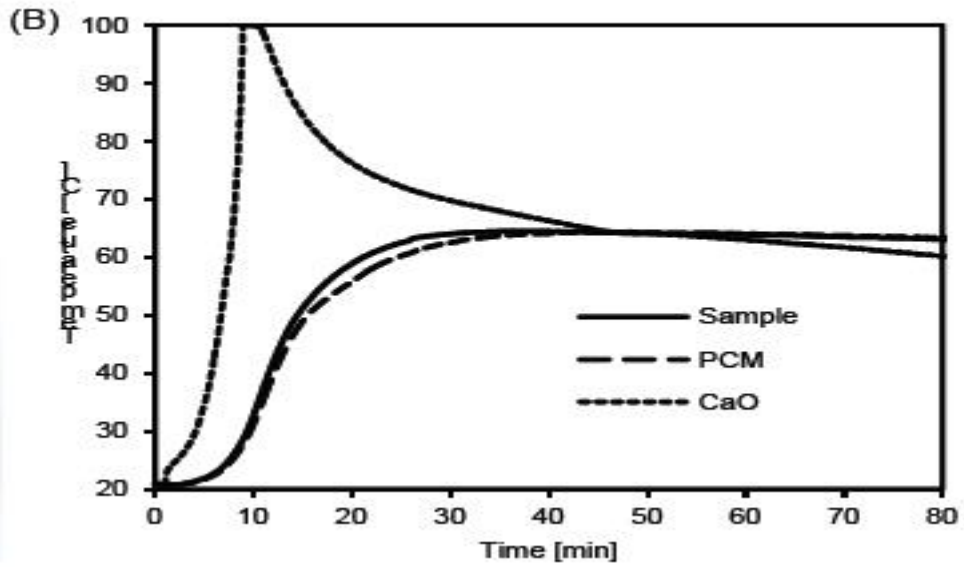


Paper Based Diagnostic

"Stand-Alone" Sistemler ; Non-instrumented nucleic acid amplification (NINA, PATH)

- Geliştirilme aşamasında
- Bir kimyasal reaktör
- İsotermal amplifikasyon
- (PCM = Phase change m



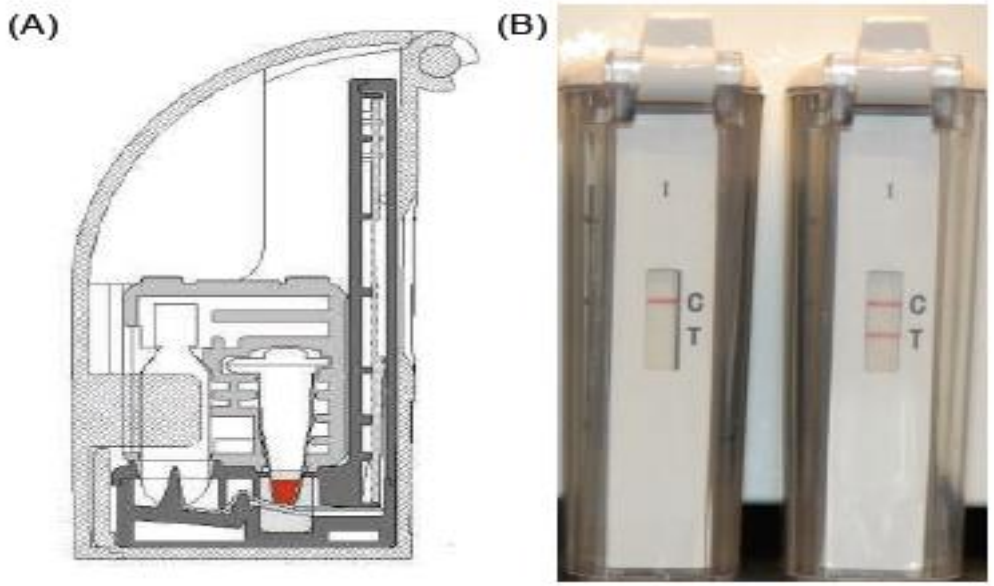


”Stand-Alone” Sistemler ; Palm PCR™ (Ahram Biosystems)

- Lityum polimer pil ile çalışıyor (4 saat)
- 39 dakika içinde 2 kb’lık bölgeyi çoğaltıyor
- Fiyatı < 6.000 $
- 12 Örnek

"Stand-Alone" Sistemler ; XCP nucleic acid detection device (Ustar Biotechnologies)/BESt Cassette (BioHelix)

- Amplifikasyon ürününü lateral flow stribe aktarıyo.
- Ürnler biotin-FAM, biotin-DİG işaretli olabiliyo.
- Amplifikasyon tüpü doğrudan kartuşa yerleştiriliyor
- İsoAmp HSV assay FDA onaylı

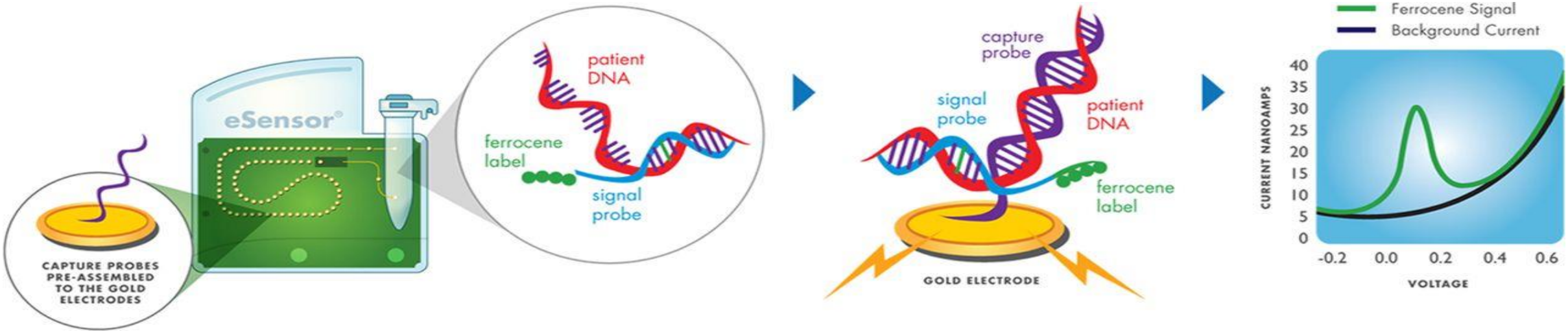


“Stand-Alone” Bütünleşik Sistemler ; eSensor (GenMark)

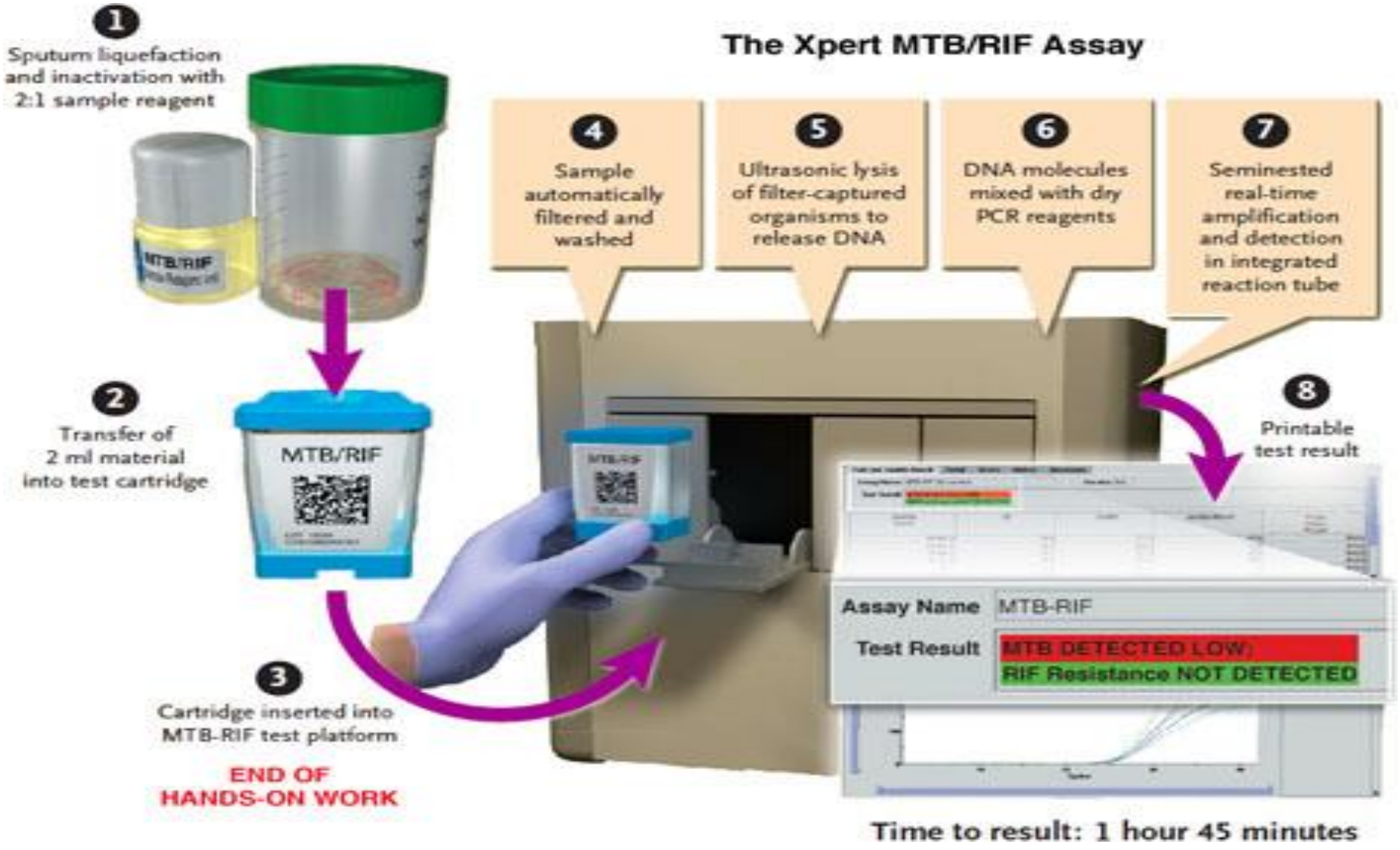
FDA onaylı solunum yolu paneli,

HCV RNA ve Genotiplendirme

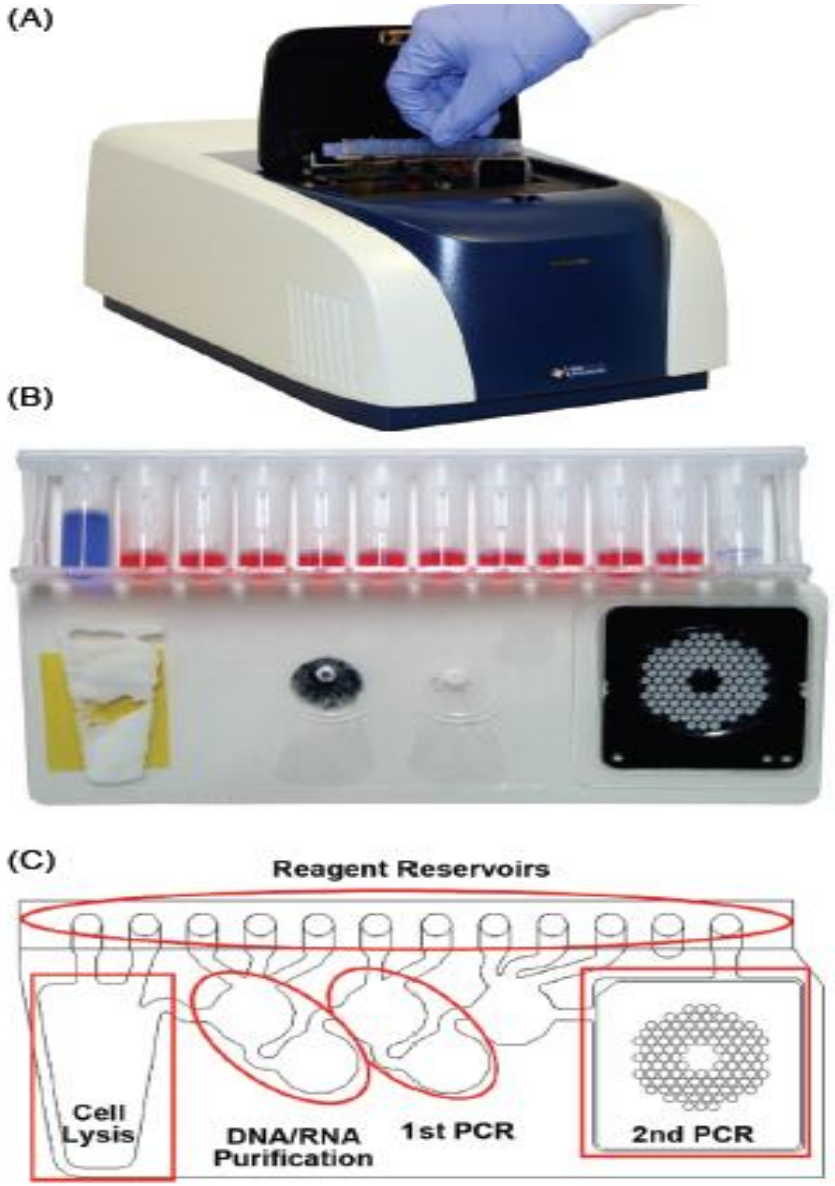
kiti yolda



"Stand-Alone" Bütünleşik Sistemler ; GeneXpert (Cepheid)

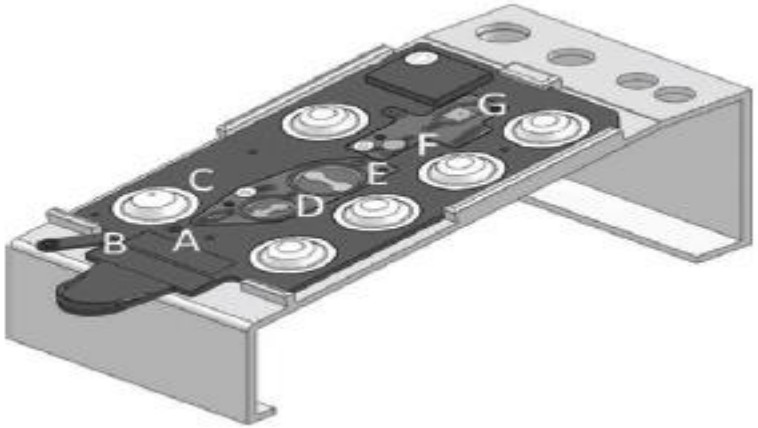


"Stand-Alone" Bütünleşik Sistemler ; FilmArray (Biofire)



”Stand-Alone” Bütünleşik Sistemler ; Great Basin Portrait Analyzer

- FDA C. difficiler kiti var
- Blisterli kartuj
- 75 dakikada sonuç
- Tam otomatize



"Stand-Alone" Bütünleşik, End Point Saptamalı Entegre Sistemler

The Simple Amplification Based Assay (SAMBA)

- NALF + NASBA Benzeri amplifikasyon sistemi,
- Kartuşlu ve tümüyle kapalı, kontaminasyon yok

- Semikantitatif: VY'ü 1000'in altında ya da üstünde şeklnde ölçüyor

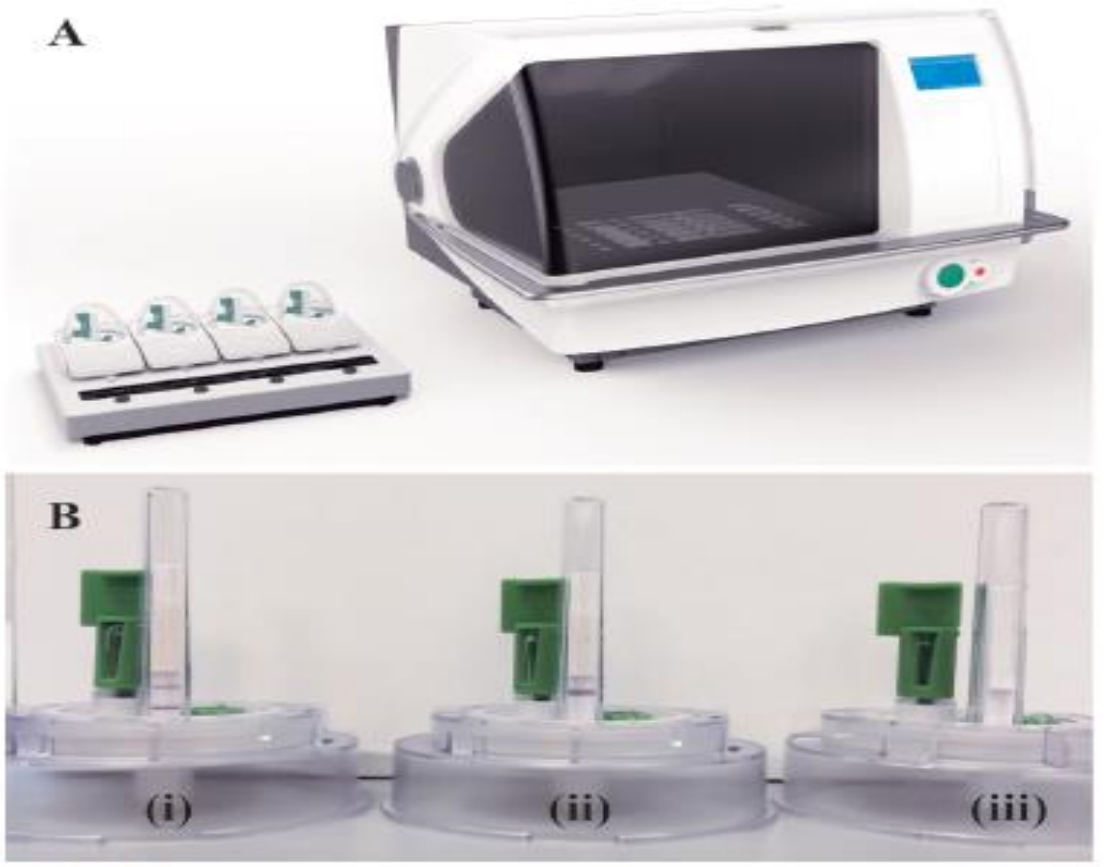


FIG 1 SAMBA semi-Q system. (A) SAMBAprep (right) and SAMBAamp (left) instruments. (B) SAMBAamp cartridge showing results for (i) >1,000 and (ii) <1,000 copies/ml and (iii) invalid results.

“Point of care” Test örnekleri

Platform	Üretici	Örnek Hazırlama	Amplifikasyon Yöntemi	Saptama Yöntemi	Test Süresi (Dakika)
GeneXpert	Cepheid	Evet	PCR	Gerçek Zamanlı Fluoresans	90-120
Liat Analyzer	IQuum	Evet	PCR	Gerçek Zamanlı Fluoresans	<60
FilmArray	IdahoTechnolgies	Evet	PCR	Son Fluoresans Ölçümü	60
LA-120	Eiken	Hayır	LAMP	Gerçek Zamanlı Fluoresans	<60
Twista	TwistDx	Hayır	RPA	Gerçek Zamanlı Fluoresans	<20
GenieII	Optigene	Hayır	LAMP	Gerçek Zamanlı Fluoresans	<20
BEStCassette	U-StarBiotech BioHelix	Hayır	İzotermal	Lateral Flow	Bilinimiyor
Simplexa Direct Amplification Disc	Focus 3M Integrated Cycler	Evet	PCR	Gerçek Zamanlı Fluoresans	60

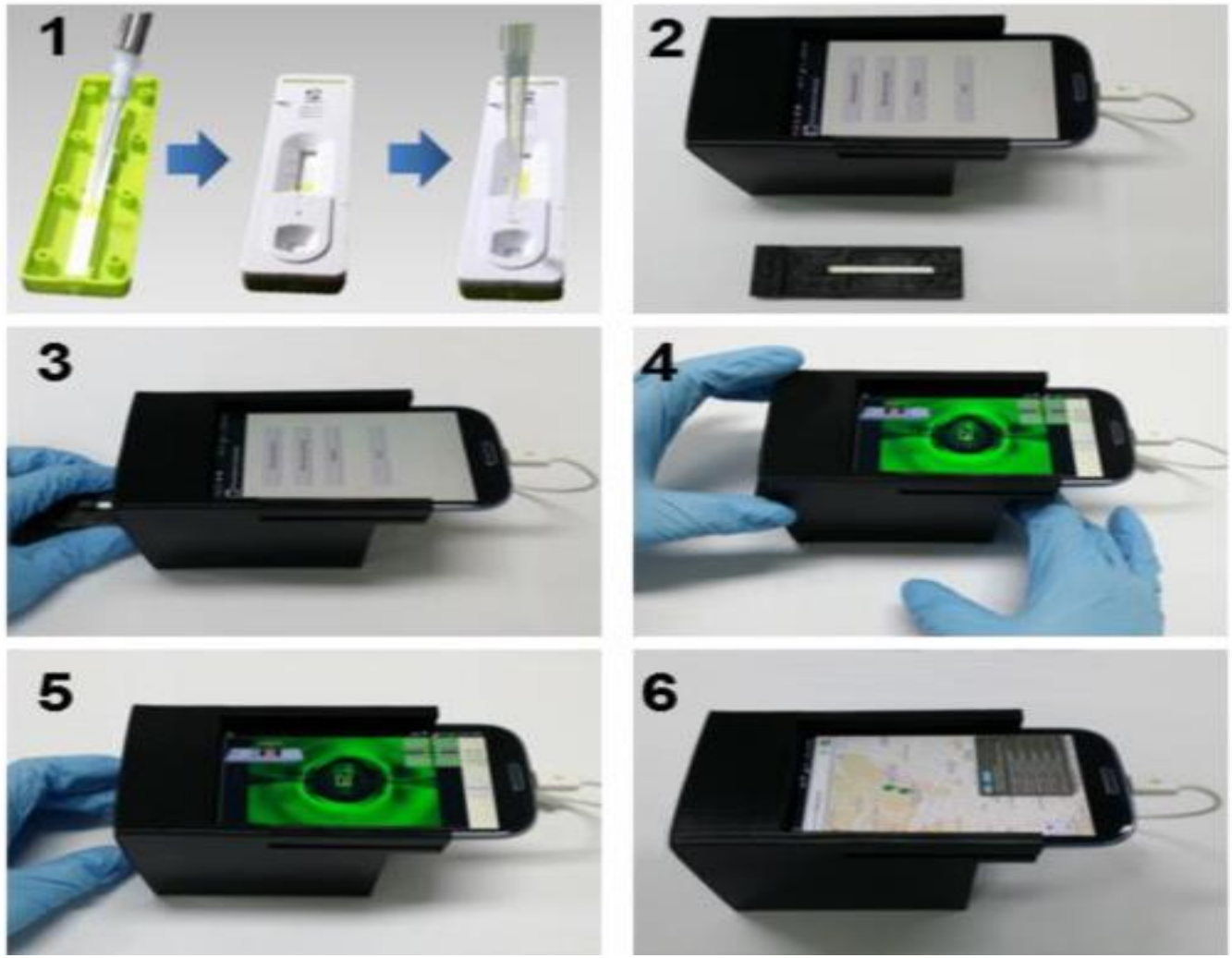
IVYSPRING INTERNATIONAL PUBLISHER

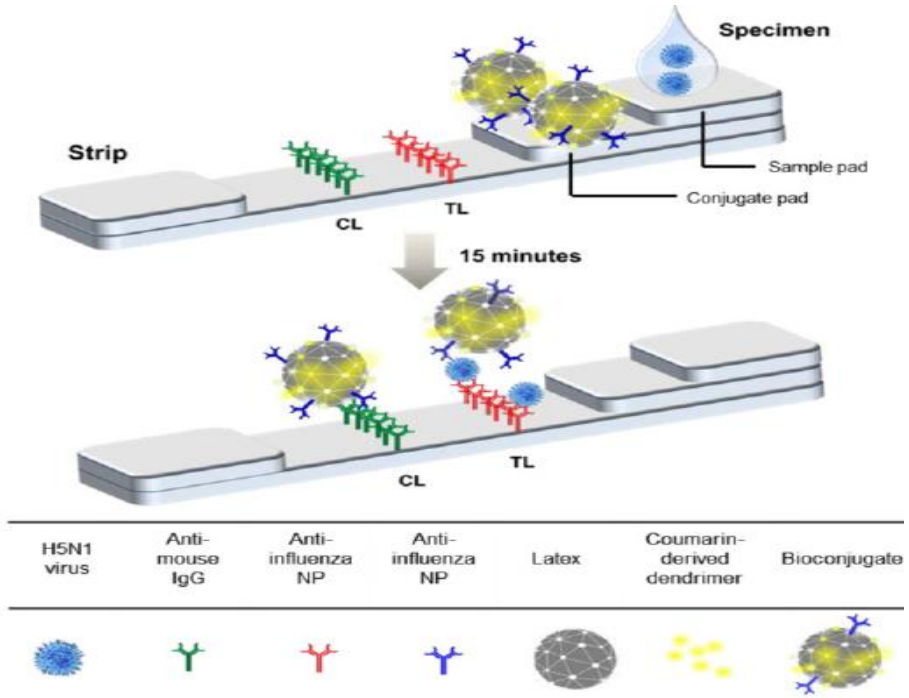
Theranostics
2016; 6(2): 231-242. doi: 10.7150/thno.14023

Research Paper

Smartphone-Based Fluorescent Diagnostic System for Highly Pathogenic H5N1 Viruses

Seon-Ju Yeo[1‡], Kyunghan Choi[2‡], Bui Thi Cuc[1], Nguyen Ngoc Hong[1], Duong Tuan Bao[1], Nguyen Minh






001

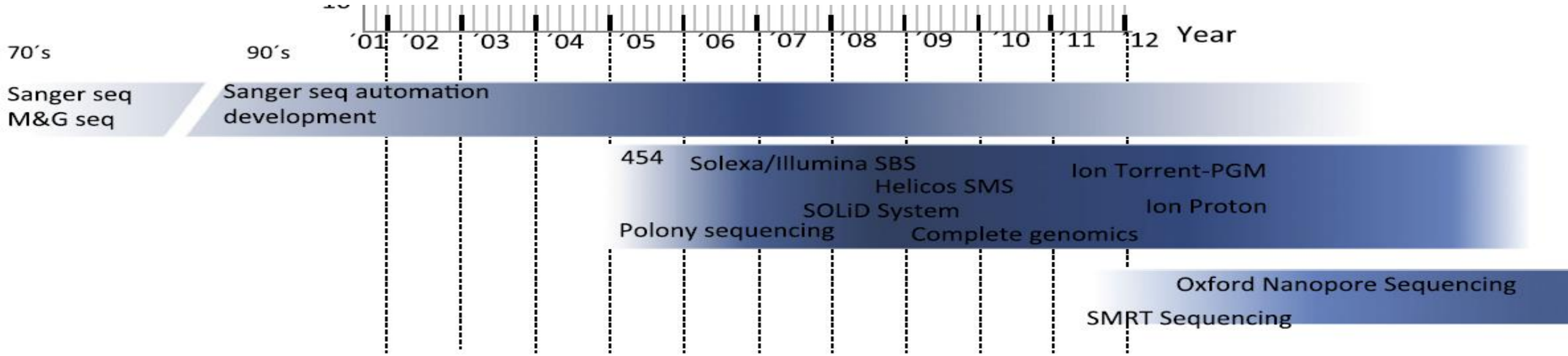
Lab-on -Chip

Yeni Kuşak Dizileme

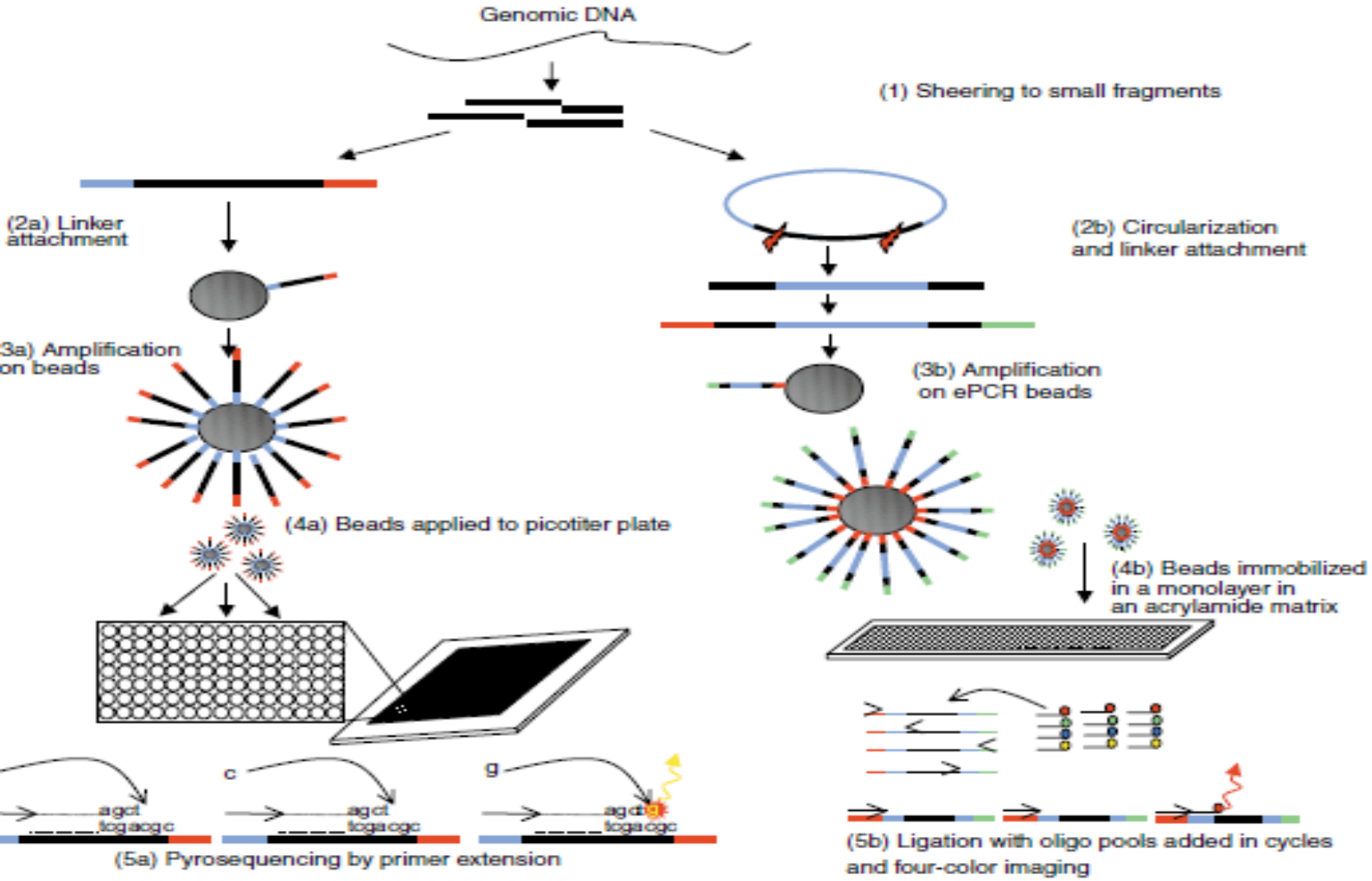
- Enzimoloji,
- Görüntüleme/Saptama
- Mikroakışkan (microfluidic) alanındaki güncel gelişmeler
- Cihazların minyatürize edilebilmesi

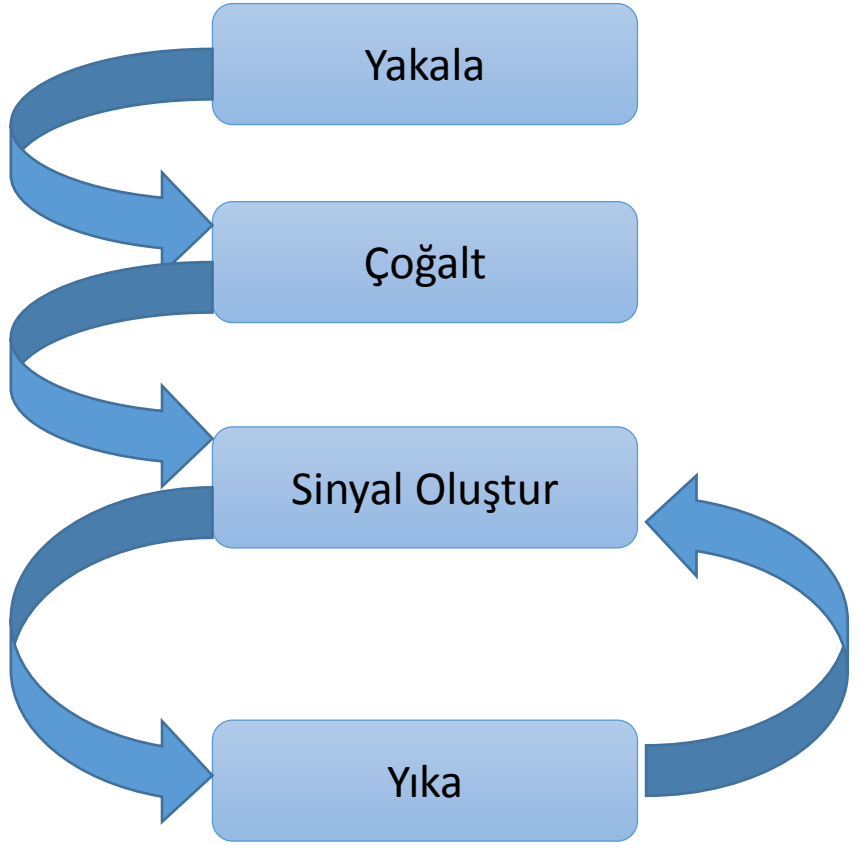
➔ Yeni Kuşak Dizileme Teknolojileri

Yeni Kuşak Dizileme Sistemleri

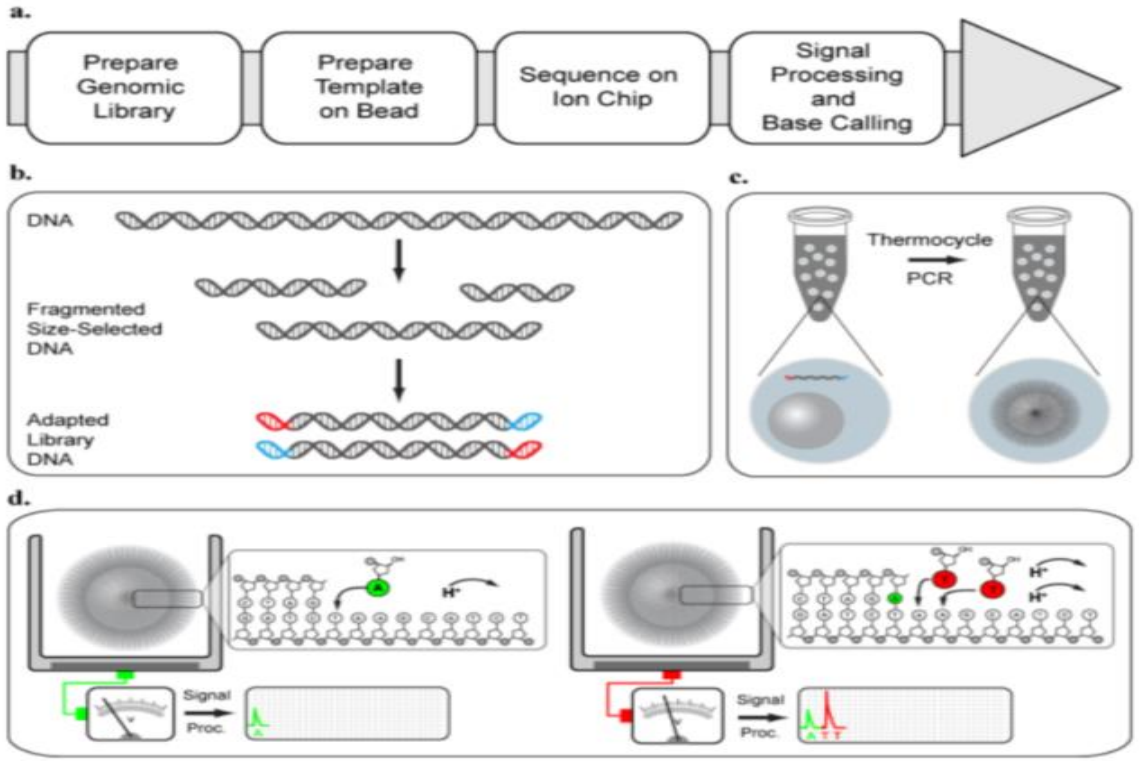


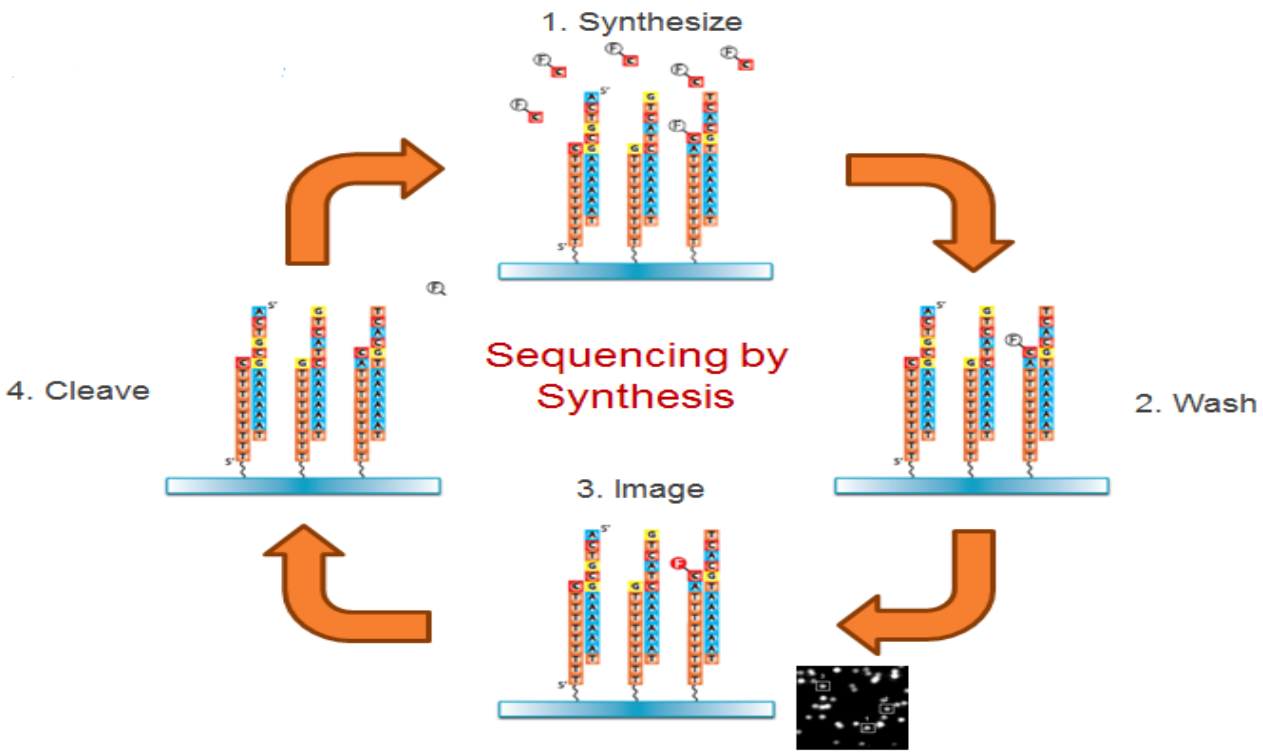
İkinci Kuşak (Yeni Nesil) Dizileme Yöntemleri



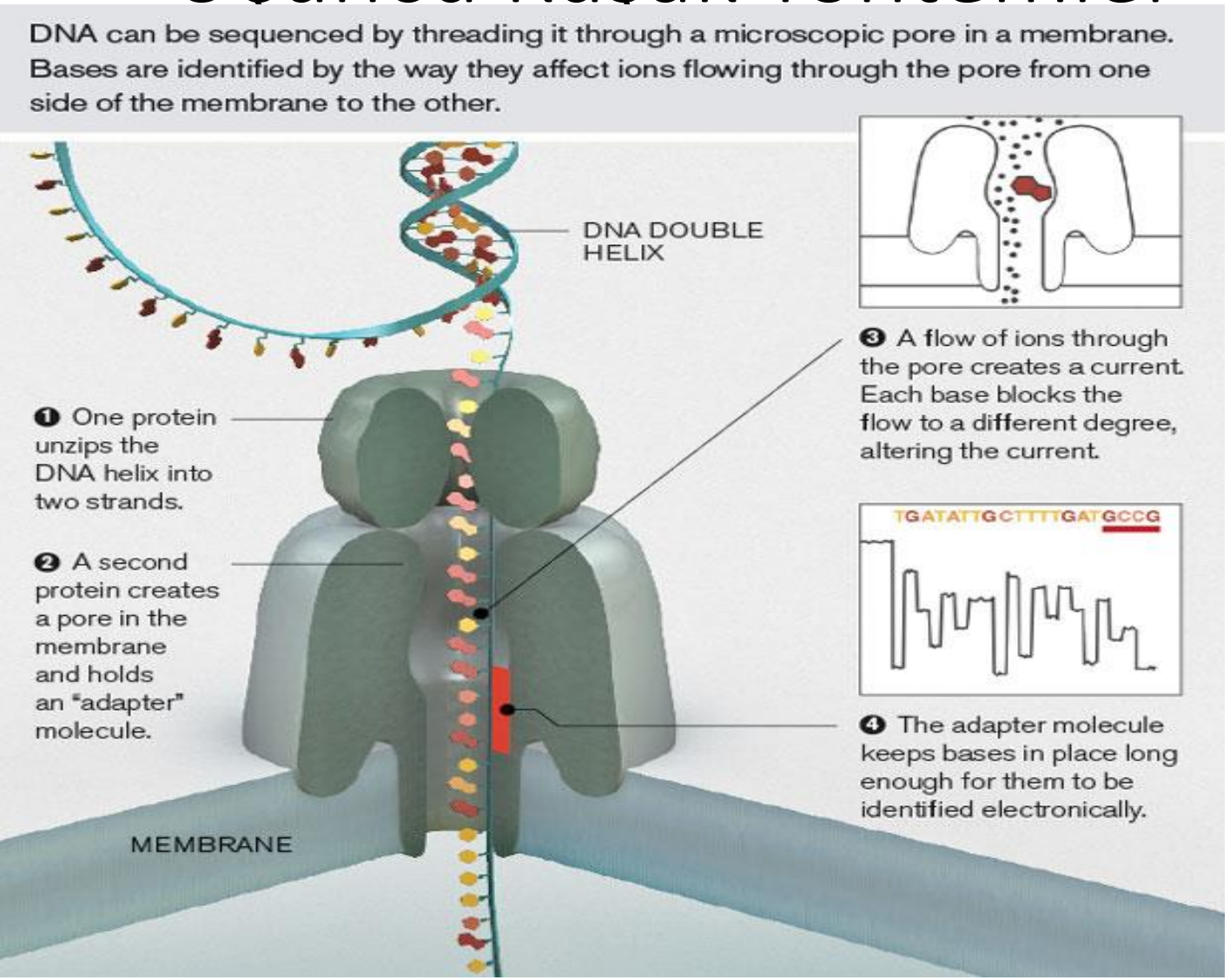


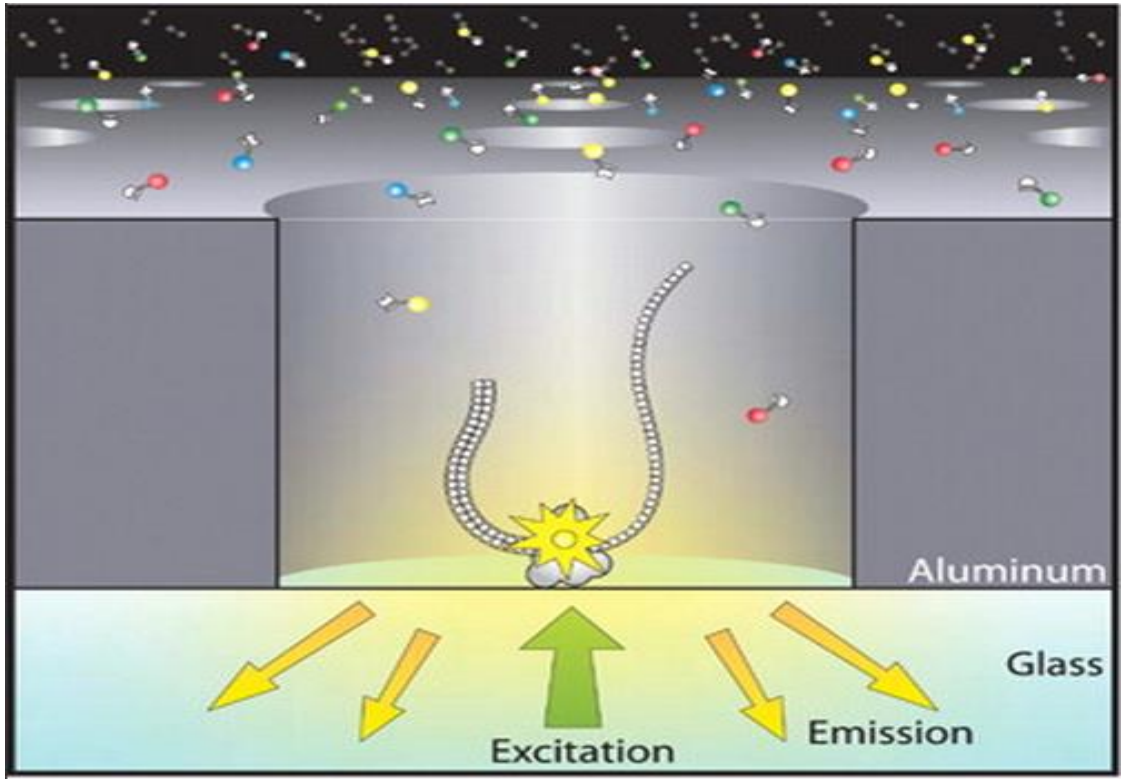
İkinci Kuşak (Yeni Nesil) Dizileme Yöntemleri





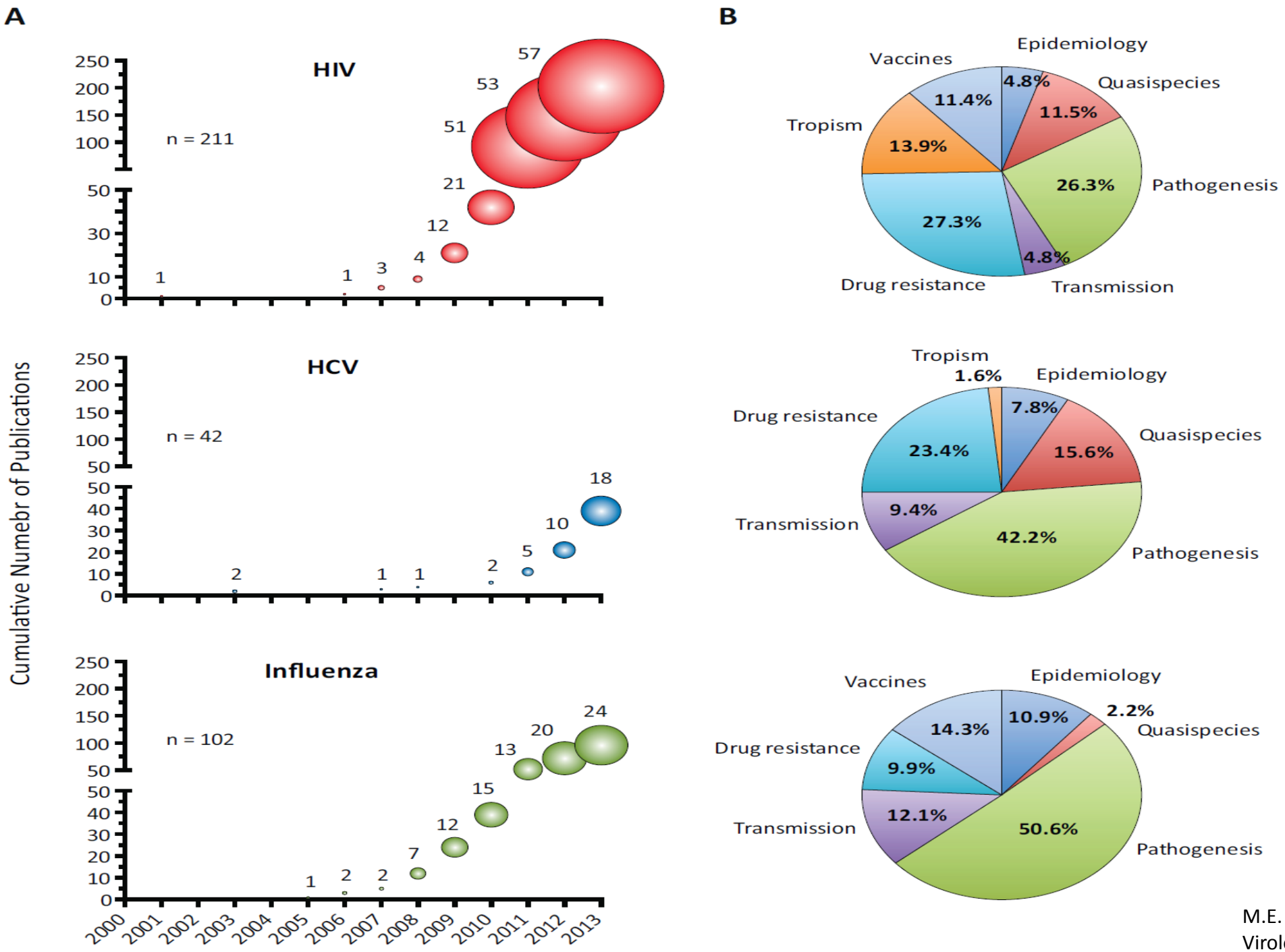
Üçüncü Kuşak Yöntemler





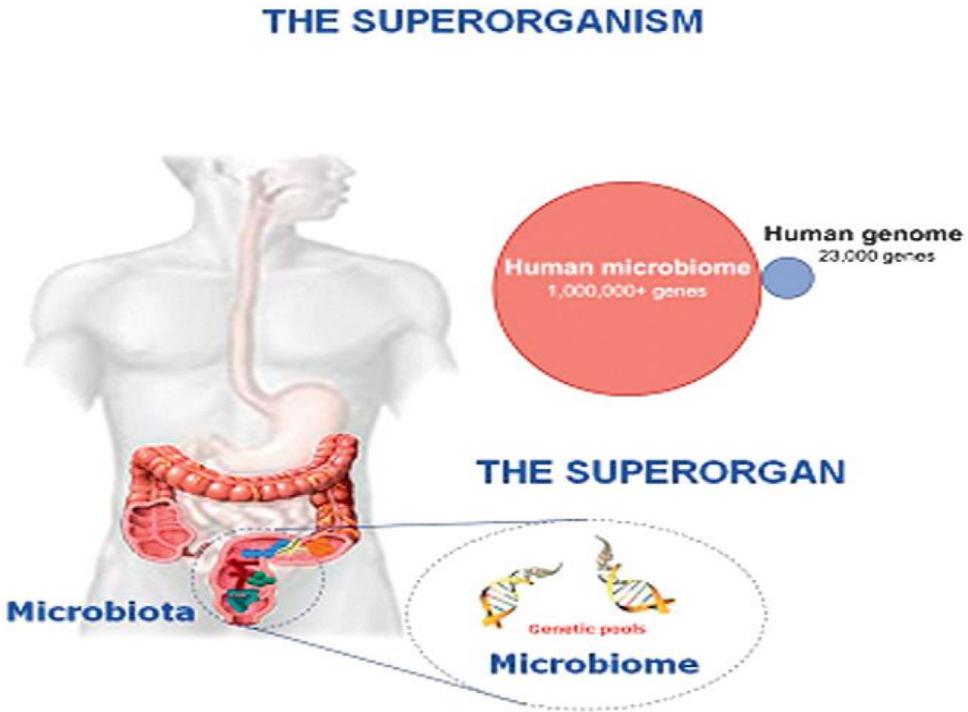
Temel Yeni Kuşak Dizileme Uygulamaları

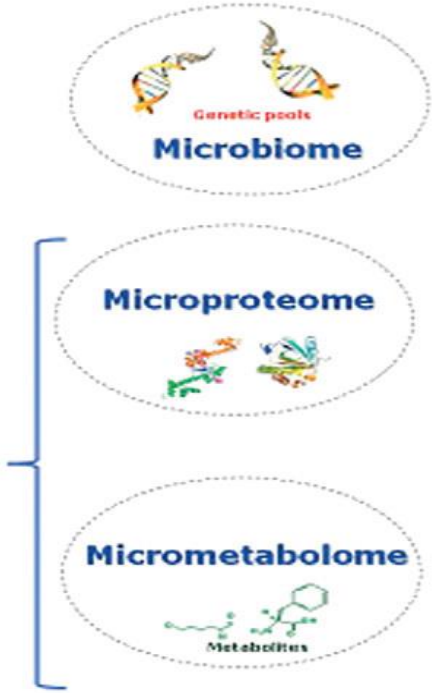
- Metagenomik yaklaşımlar ve patojen tanımlama;
- Patojenin konakla ve konaklar arası etkileşiminin incelenmesi (Salgın analizi, moleküler epidemiyoloji);
- Konak-etken ilişkisi çalışmaları (İlaç direnci, aşı ve yeni tedavi yöntemlerinin geliştirilmesi)
- Konağın genetik yapısının incelenmesi (infeksiyonlara yatkınlık, direncin anlaşılması ➔ kişiselleşen tıp)

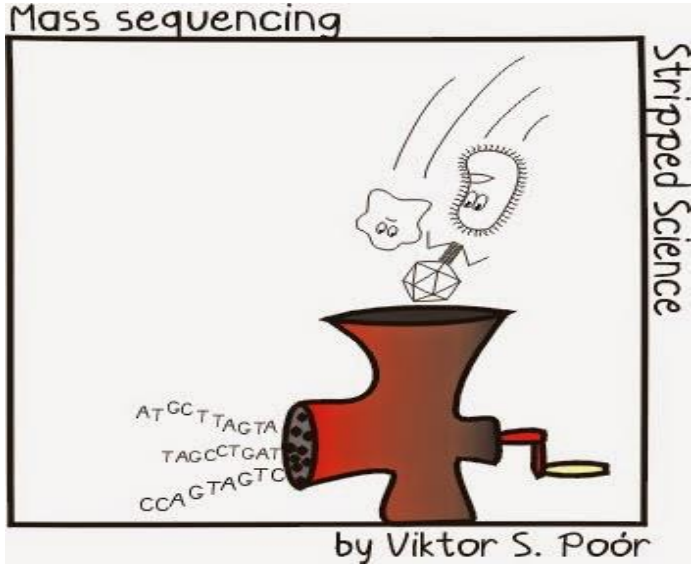


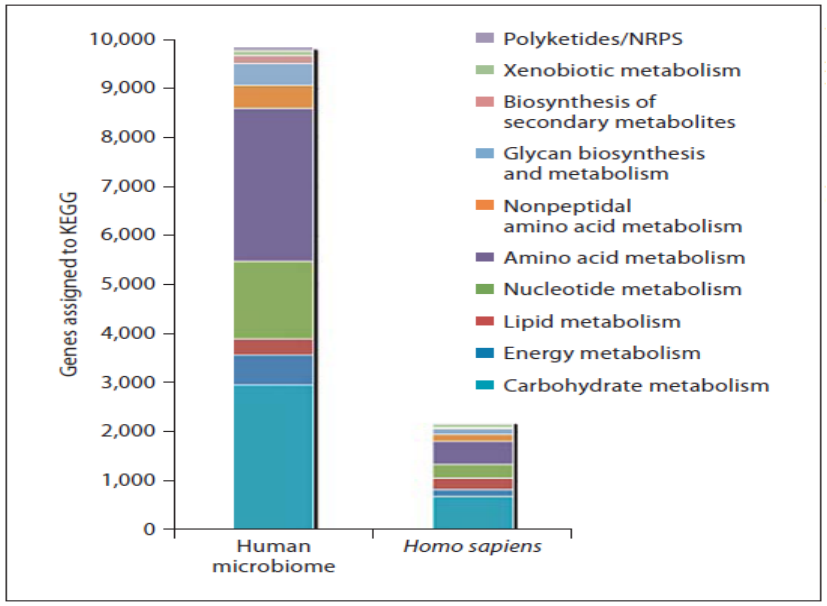
M.E. Quiñones-Mateu et al. / Journal of Clinical Virology 61 (2014) 9–19

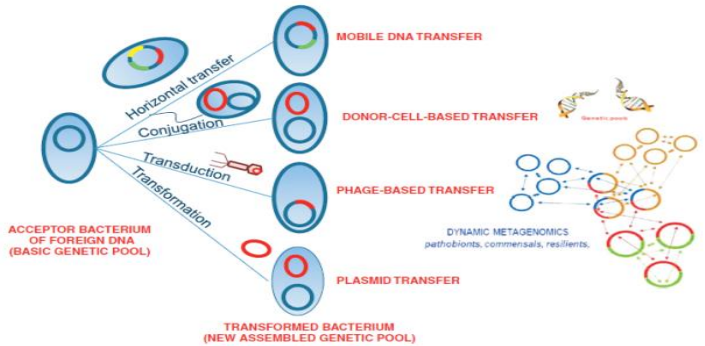
Metagenomik Yaklaşım



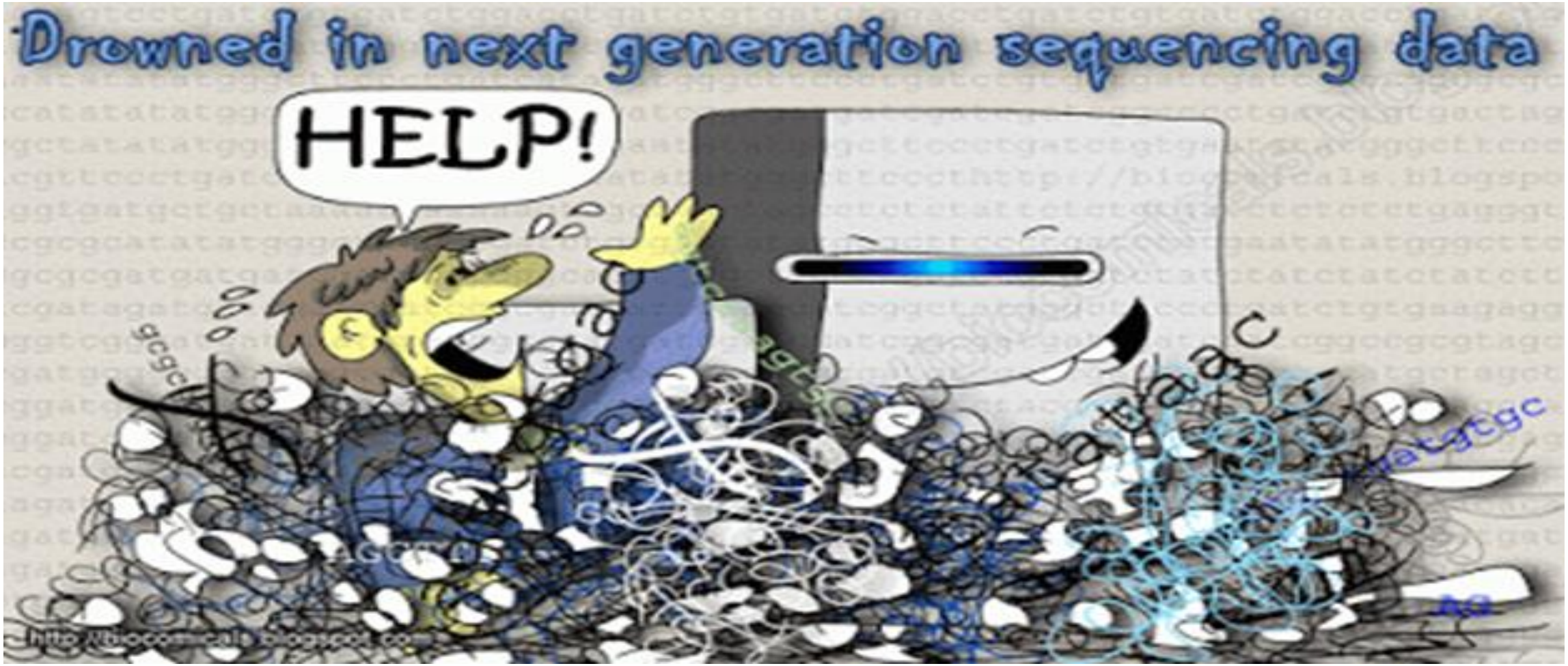




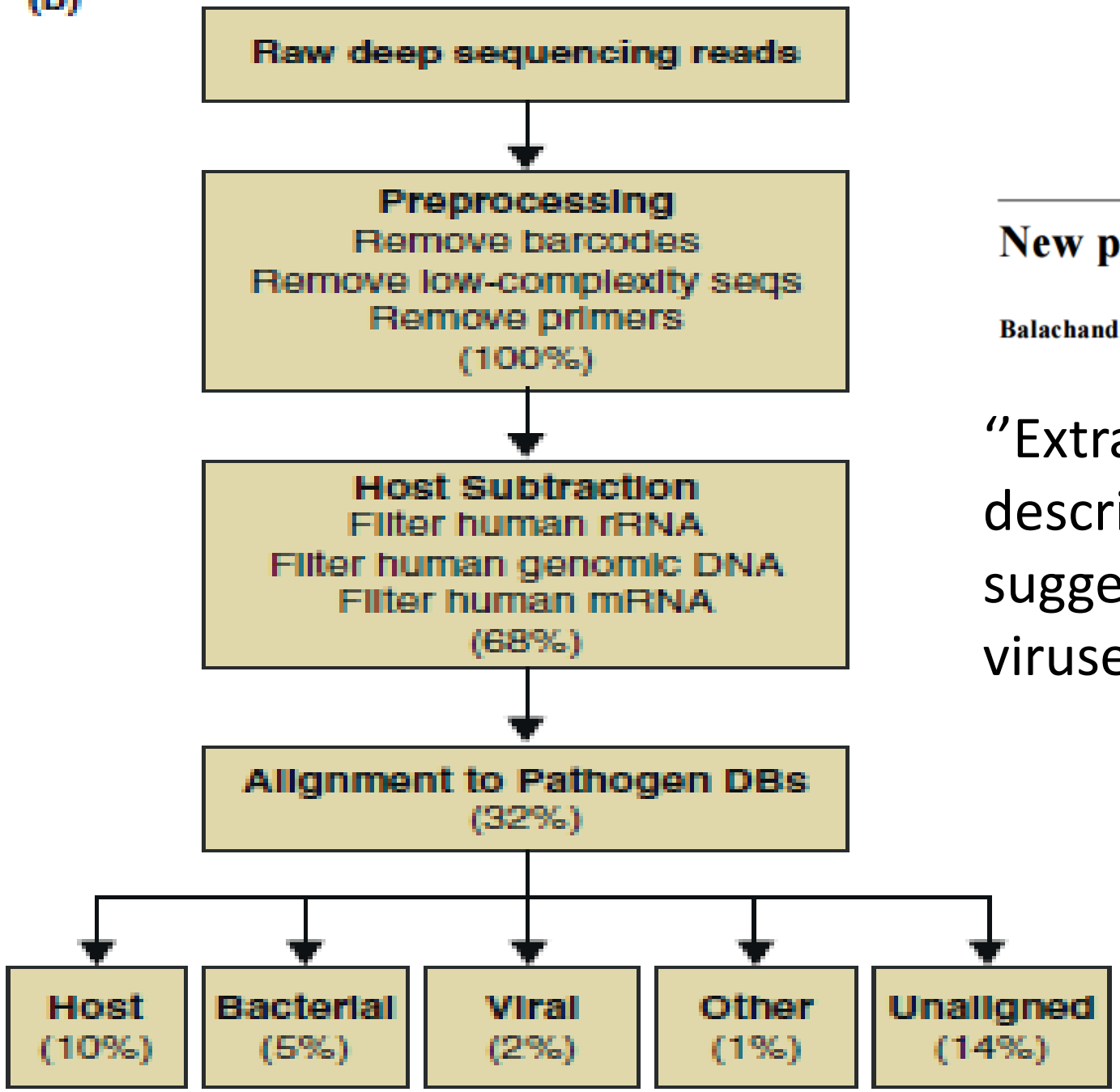




Yeni Kuşak Dizileme Yöntemlerinin Zayıf Halkası = **Biyoinformatik**



(b)



Current Opinion in Microbiology

New pathogen discovery

Balachandran Ravindran*

"Extrapolation of this to about 5486 described mammalian species suggests that more than **<u>320,000</u>** viruses are waiting to be discovered"

Saha Çalışması

Mobile Health Meetup

London, United Kingdom

Founded Mar 18, 2015

About us...

Mobile Healthers 283

Upcoming Meetups 1

Past Meetups 3

Our calendar

Sequencing Ebola in the Field

Sep 1, 2015 · 6:30 PM

This location is shown only to members

EMERGING INFECTIOUS DISEASES®

Volume 22, Number 2—February 2016

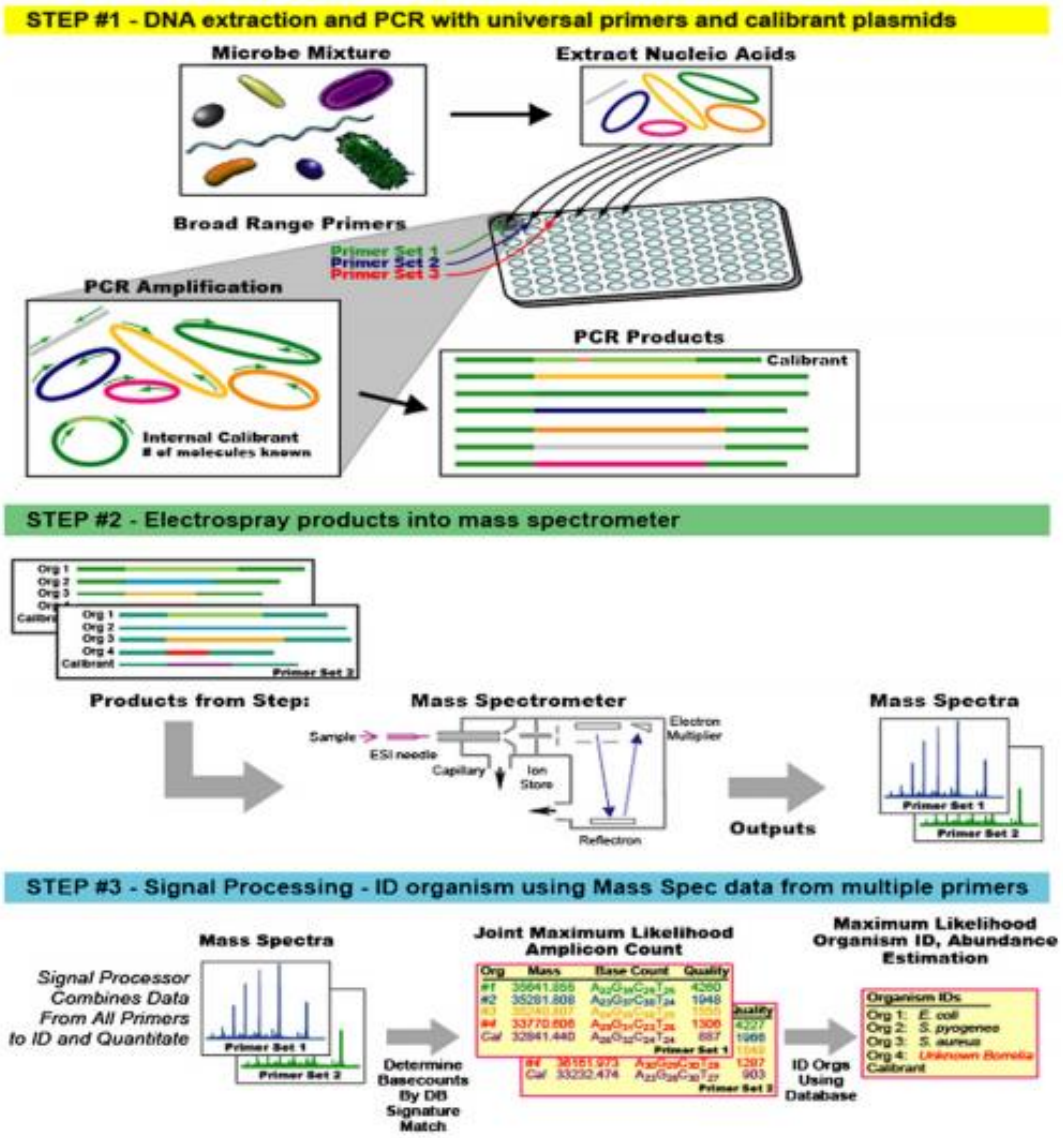
Dispatch

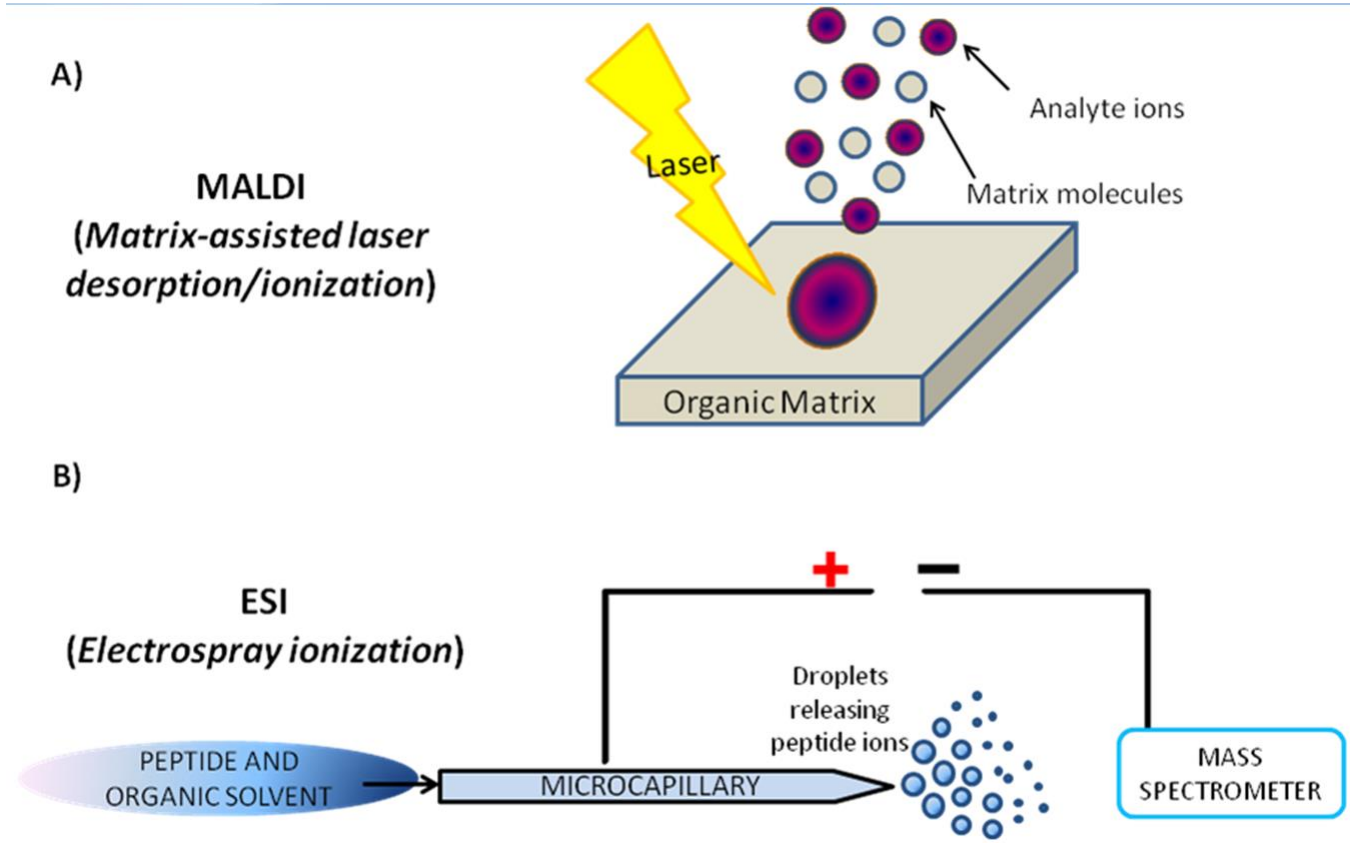
Nanopore Sequencing as a Rapidly Deployable Ebola Outbreak Tool

Thomas Hoenen✉, Allison Groseth, Kyle Rosenke, Robert J. Fischer, Andreas Hoenen, Seth D. Judson, Cynthia Martellaro, Darryl Falzarano, Andrea Marzi, R. Burke Squires, Kurt R. Wollenberg, Emmie de Wit, Joseph B. Prescott, David Safronetz, Neeltje van Doremalen, Trenton Bushmaker, Friederike Feldmann, Kristin McNally, Fatorma K. Bolay, Barry Fields, Tara Sealy, Mark Rayfield, Stuart T. Nichol, Kathryn C. Zoon, Moses Massaquoi, Vincent J. Munster, and Heinz Feldmann

Kütle Spektrofotometresi:

PCR Coupled to Electrospray Ionization Mass Spectrometry (PCR/ESI-MS)





Broad Assay Menu and Sample Types

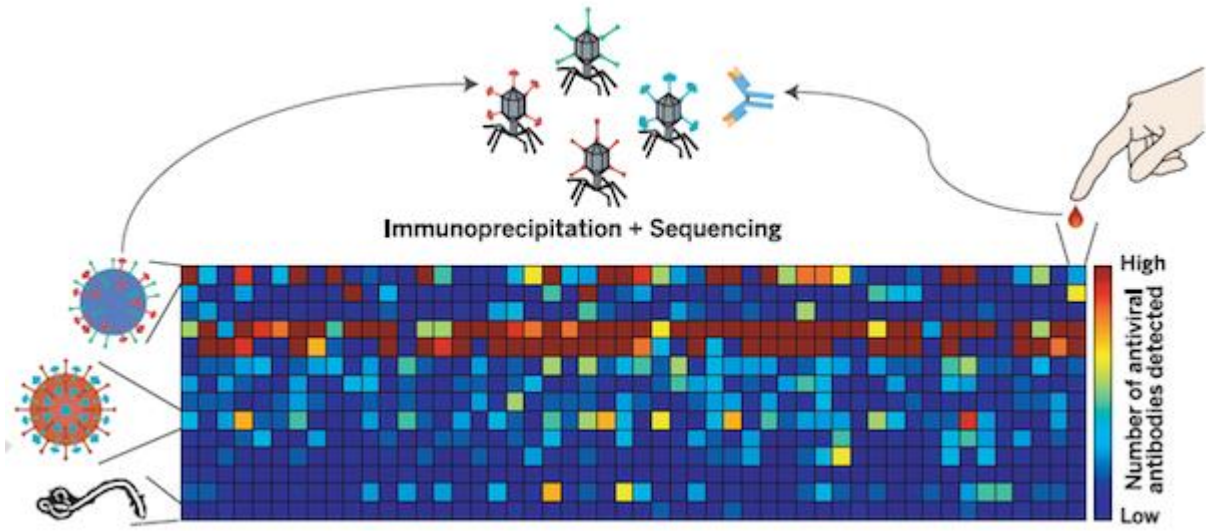
ASSAY	COVERAGE	SAMPLE TYPE
BAC BSI	**750+ Bacteria**, Candida and 4 Antibiotic Resistance Markers: mecA, vanA, vanB and kpc	5ml EDTA whole blood
BAC SFT		Sterile fluids and tissues
BAC LRT	Identical coverage as BAC BSI and BAC SFT with additional **semi-quantitative threshold**	BAL and ETA
Fungal	**200+** fungi	BAL and Isolates
Viral IC	**130+** viruses in 13 reporting groups	Plasma

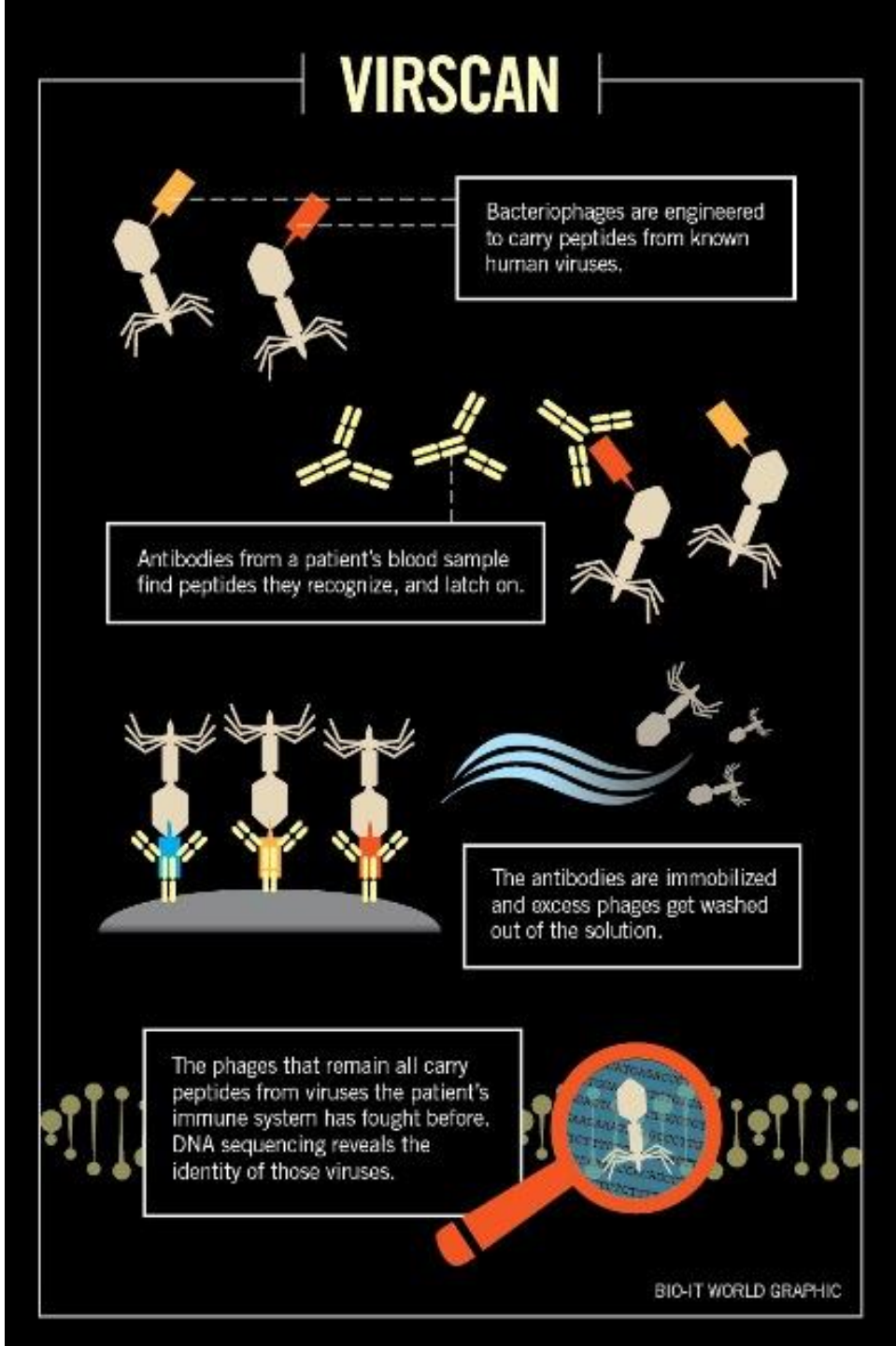
CE Marked. For In Vitro Diagnostic Use.

Serolojide
Esikiden Gelen Yeni Bir Yaklaşım
“Phage Display”

93,000 Kısa DNA fraagmanı
206 virus türüne ait
1,000 bilinen insan virus
kökenini tanıyabilme

$25






100% NATURAL

İZOTERMAL AMPLİFİKASYON TEKNİKLERİ

HIGHTHROUGHPUT TEKNOLOJİLER

MİNYATÜRİZASYON

LAB-ON-CHİP

MİKROAKIŞKAN TEKNOLOJİSİ

NANOTEKNOLOJİ

ROBOTİK VE TAM OTOMASYON

MOBİL TEKNOLOJİ

YENİ BİR ÇAĞ

OTOMASYON

SANTRALİZASYON

~~4 P TIBBI~~

~~5 P TIBBI~~

6 P TIBBI

LEAN MİKROBİYOLOJİ

POCT

DE-SANTRALİZASYON

KONSALİDASYON

ON-SİTE TESTING

AID

DEMOKRATİZASYON

"REALTİME" MANAGMENT

TERAGNOSTİK

Lean Microbiology-Removing «Muda»

Artı Değer Üretmeyen Etkinliklerin Sonlandırılması

- Tip 1 Muda: «İşe yaramıyorsa yapma» yaklaşımı ile hemen elimine edilebilecekler.

- Tip 2 Muda: İşlerin şu an için yapılma şekli için gerekli olan ve elimine edilemeyecekler (denetim, gözetim, kalite kontrol için gerekli olanlar…)

Point of Care (Yerinde Bakım)

«POC testing as patient specimens being assayed at or near the patient, with the assumption that test results will be available instantly or in a very short time frame, to assist care-givers with immediate diagnosis and/or clinical intervention.»

POC testlere olan gereksinimler sağlık altyapıları güçlü ve herkes için ulaşılabilir olan gelişmiş ülkelerle sağlık altyapısı zayıf ve çoğunlukla erişilebilir tek test seçeneği olan az gelişmiş ülkelerde farklı

Kolay uygulanabilir olmakla birlikte POC testler geçmişte genel olarak:

- Teknisyen hatalarına açık
- Duyarlılık ve özgüllükleri düşük

Affordable
Sensitive
Specific
User-friendly
Rapid
Equipment-free
Delivered to those in need

Gelişmiş ülkelerde POCT gereksinimleri:

- **Gelişmiş laboratuvar altyapısı olan sağlık kurumlarında acil ve hızlı tedavi kararı gerektiren durumlarda**
- **Muayenehaneler – poliklinikler → 15 dakikada sonuç (Multiparametrik Testler ve Teragnostikler)**

- **Testlerin bakım yerinde bu konuda minimum eğitim ve deneyime sahip personel ya da doğrudan hekim tarafından yapılması**

- Laboratuvar hizmetlerinin reorganizasyonu → Kompleks merkez laboratuvarlarından küçük bağımsız ve farklı hizmet noktalarına dağılmış laboratuvarlar → Desantralizasyon, konsolide laboratuvarlar

Az gelişmiş ülkeler ya da gelişmiş laboratuvar olanaklarına erişimin kısıtlı olduğu yerlerde

Hastalık profilleri daha farklı

Ciddi altyapı eksiklikleri

Erişilebilir tanı araçları kısıtlı

Kısıtlı personel

Ulaşım sorunları (hem hasta hem de örneklerin gönderilmesi)

Hastanın izlenmesinde güçlükler

Hastalık profilleri ve öncelikler farklı

Aynı gün içersinde sonuç alınması bile yeterli olabilir

- Toplumda kullanımı:
- Eczanelerde test yapılması
- Kendikendine testler ve evde testler
- Mobil teknolojiler
- Sahada mobil teknolojiler

AID

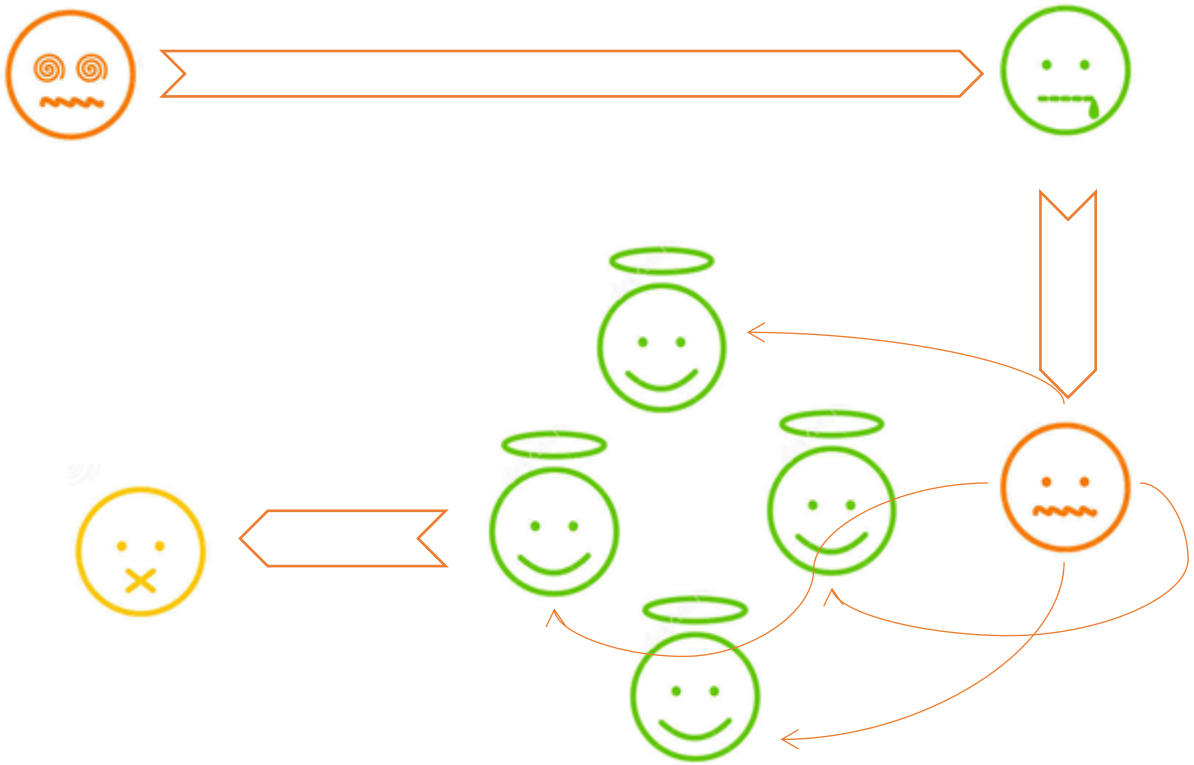
Antimicrobial Stewardship

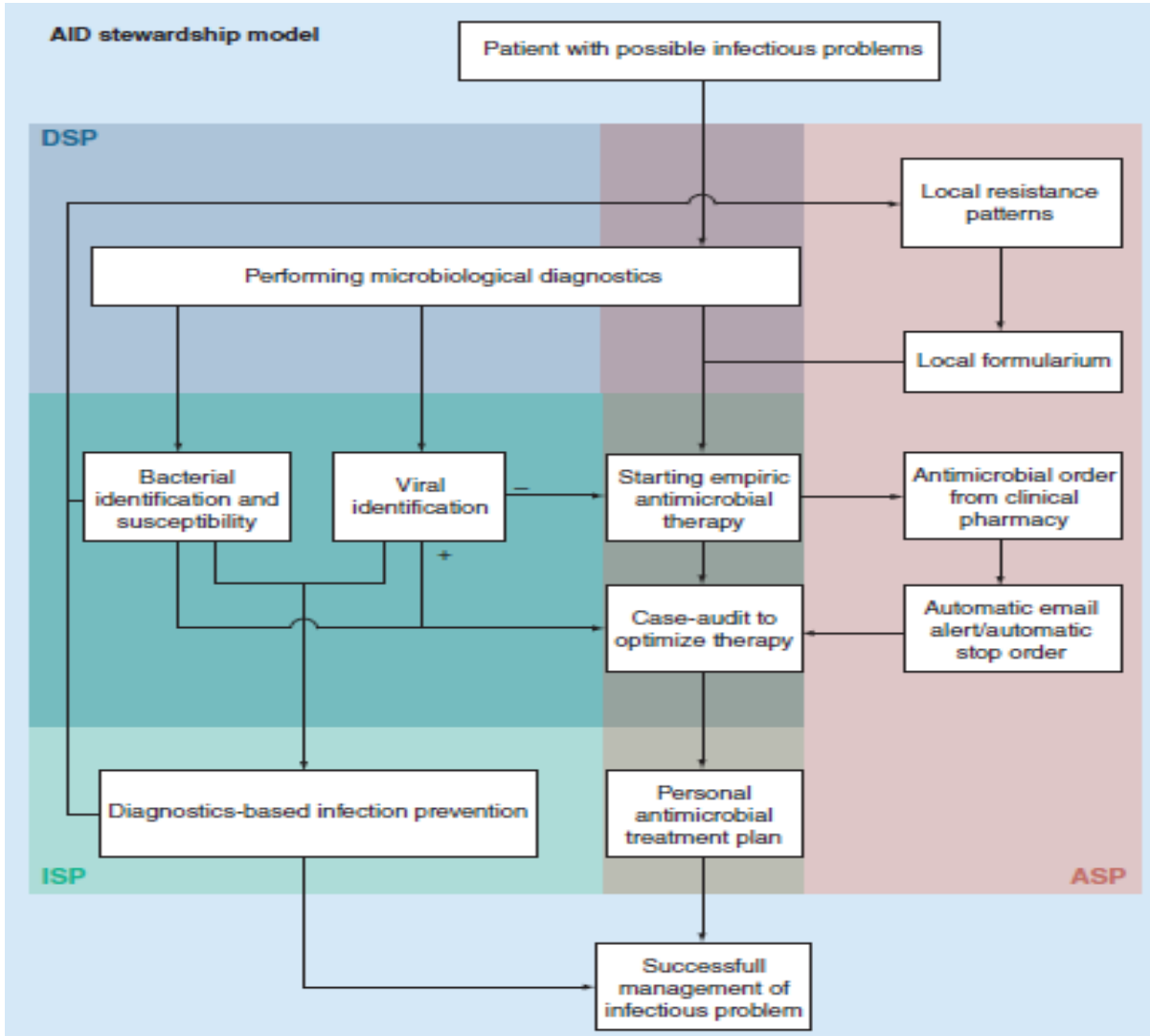
–

Infection Control Stewardship

–

Diagnostic Stewardship





Toptancı Teknolojiler Neleri Değiştirecek

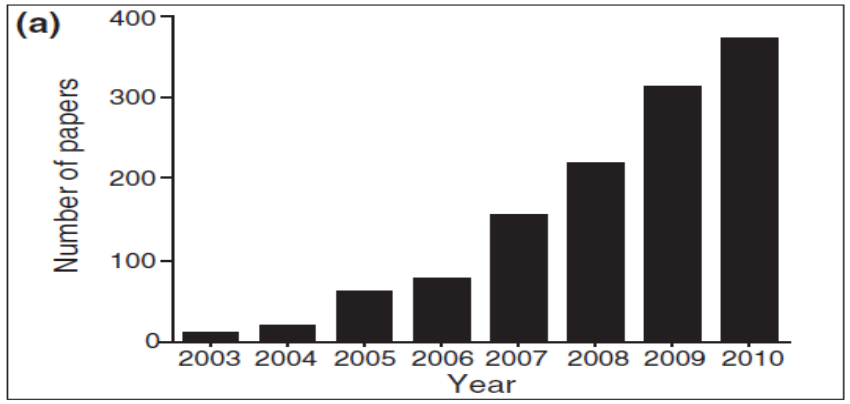
- Yeni kuşak dizileme
- Digital PCR
- Mikroarrayler
- Portatif MS

Toptancı Teknolojiler Neleri Değiştirecek

- Tüm etkenlerin saptanması
- Gerçek sayılara dayanan kantitasyon
- Yeni etkenlerin keşfi
- Yeni hastalık, etken hastalık ilişkilerinin keşfi
- Tam genom incelemeler ile yeni tedavi seçeneklerinin tanımlanması

- Tek molekül dizileme
- Direncin daha iyi kontrol altına alınması
- Kişiye özgü tedavi tasarımları
- Biyobelirteç tanımı

Yeni Etkenlerin Keşfi



(b)

First marine viral metagenome
Breitbart et al., 2002
M: sg-Sanger; S: seawater

75% of sequences in marine sediments are unknown
Breitbart et al, 2004
M: sg-Sanger; S: ms

Novel RNA viruses
Culley et al., 2006
M: sg-Sanger; S: seawater

Plant RNA viruses in human feces
Zhang et al, 2006
M: sg-Sanger; S: feces

Novel highly divergent picobirnavirus, picornavirus, norovirus and anellovirus
Finkbeiner et al, 2008
M: Sanger; S: feces

Low diversity of known viruses in infant gut <3 month old. Diversity increases with age.
Breitbart et al., 2008
M: Sg, Sanger; S: feces

Marine virome
High percentage of unknowns
Desnues et al, 2008
M: 454NGS; S: seawater

Novel Borna virus
Honkavuori et al, 2008
M: 454NGS; S: Turkey feces

Novel viruses in hotsprings
Schoenfeld et al, 2008
M: ND; S: hotspring water

Novel Arenavirus
Palacios et al., 2008
M: 454NGS; S: Bush kuru rat

Novel Orthoreovirus and orbirus
Victoria et al., 2008
M: 454NGS; S: ip, sb, hf, se

Novel Paralysis virus
Djikeng et al., 2008
M: SISPA

Novel mycovirus
Bishop-Lilly et al., 2010
M: 454NGS; S: moskitoes

Novel chimpanzee stool-associated circular viruses
Blinkova et al., 2010
M: 454NGS; S: b, feces, sp, brain

Astrovirus as etiology of mink shaking syndrome
Blomstromet al., 2010
M: 454NGS; S: brain

Novel simian hemorrhagic fever virus.
Lauck et al., 2011
M: 454NGS; S: plasma

Multiple novel species in pigs: astrovirus, bocavirus etc.
Shan et al., 2011
M: 454NGS; S: feces

Novel turkey hepatitis virus as the etiology of Turkey viral hepatitis
Honkavuori et al., 2011
M: 454NGS; S: liver, int., panc.

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

First gut viral metagenome
Breitbart et al., 2003
M: sg, Sanger; S: feces

Novel anelovirus
Breitbart et al, 2005
M: sg-Sanger: blood

Novel parvoviruses in human sera
Jones et al, 2005
M: SISPA, RACE; S: plasma

Novel bocavirus
Allander et al, 2005
M: Sanger; S: NPA

Israeli acute paralysis virus associated with honey bee disease
Cox-Foster et al., 2007
M: 454NGS; S: honey bees

Novel polyoma virus (KI polyoma virus)
Allander et al., 2007
M: S: NPA, feces, urine, blood

Viral metgagenomic fingerprint of soil
Fierer et al., 2007
M: sgSanger; S: soil

Virioplankton metagenome
Bench et al., 2007
M: Sanger; S: virioplankton

Novel Arenavirus: The LUJO virus
Briese et al., 2009
M: 454NGS; S: plasma, liver biopsy

Novel Marafivirus in
Al Rwahnih et al, 2009
M: 454NGS; S: grapevine

"Gayfeather miold mottle virus", a novel Cucumovirus
Adams et al., 2009
M: 454NGS; S: plant

Numerous plant and animal viruses
Rosarion et al., 2009
M: 454; S: potable, reclaimed water

Novel California sea lion anellovirus
Ng et al., 2009
M: sg-Sanger; S: Sea lion lungs

Novel sea turtle fibropapilloma virus
Ng et al., 2009
M: sg-Sanger; S: Sea turtle swabs/tissues

Solenopsis invicta virus
Valles and Hashimoto, 2009
M: RACE, Sanger; S: ant

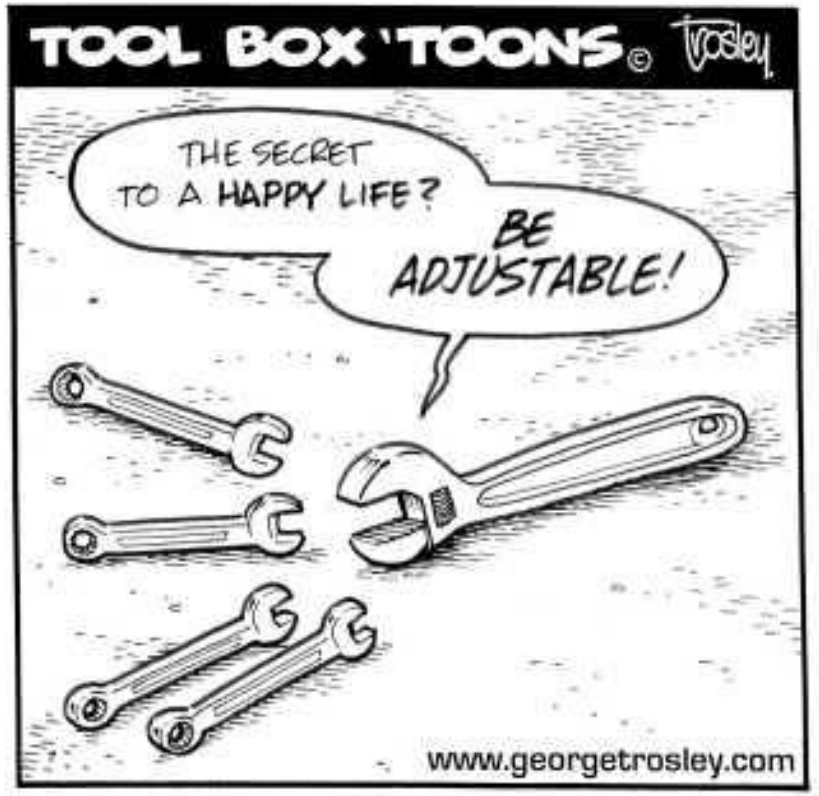
Novel picornavirus: The Klassevirus
Greningeret al., 2009
M: 454NGS, S: feces

Sweetpotatoes badnavirus and mastrevirus
Kreuze et al., 2009
M: Sanger; S: plant

Current Opinion in Virology 2012, 2:63–77

Şaşırtan Viral İnfeksiyonlar: Sadece Bakılırsa Görülebilir! (İstanbul)

pozyum



Teşekkürler…