

DDI Networks

(Drug Disease Interactions Networks)

Leman Nur Nehri, Sefa Ermancık

**+65 kanser hastalarının tedavi planlamasına yönelik,
yapay zeka ile İlaç-İlaç ve Kanser-Hastalık
etkileşim simülasyonları yapan
biyoinformatik arayüzü**



BİLİŞİM VADİSİ



sanofi

Takım

Leman Nur Nehri -Computational Biologist

ODTÜ Biyoloji Bölümü PhD (halen)
& Ankara Üniversitesi Eczacılık Fakültesi - PharmB (halen)

Bioinformatics

Cancer Modelling

Programming: Phyton, SQL, R, PPL

Artificial Intelligence: Bayesian & Markov Models, Neural Networks, Machine Learning Algorithms



Sefa Ermancık - Tıp Doktoru

Uludağ Üniversitesi Tıp Fakültesi

Programming: Web Design, Program-Based Learning (PBL) (Training Certificate)

Some selected experiences: USIM - Good Medicine Practices and Simulation Centre - Simulation and Training Workshop on Simulated Patient
Gulhane Training and Research Hospital - Medical Design and Production Center (METUM) Workshop
Utilization and Care of Laboratory Animals Certificate (Uludag University Experimental Animal Ethics Committee)

Bu platform uzmanlara, **hastaya özel**, ilaç-ilaç etkileşimi ve hastalık etkileşimleri ile ilgili bilgi desteği sağlar.

DDI Network
Interface Demo

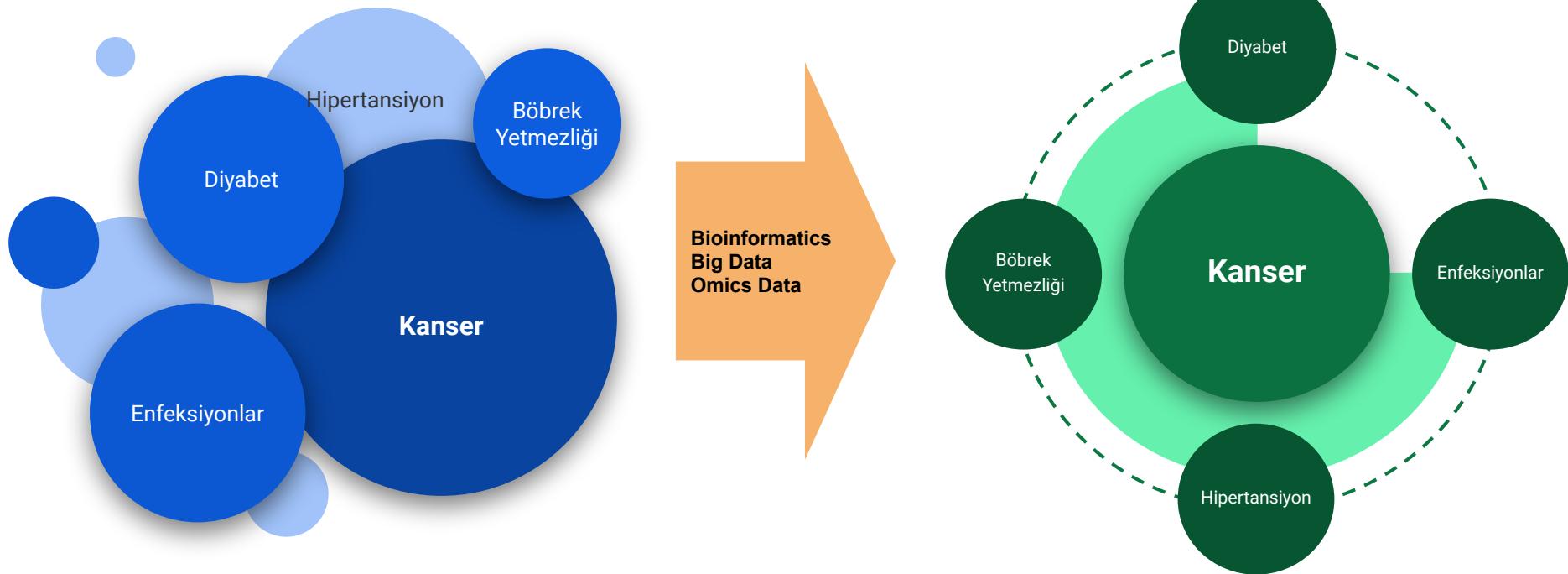
Ana Sayfa

DDI Networks

Sıkça Sorulan Sorular



Hesaplamalı biyoloji yaklaşımları ile 65+ kanser hastalarının karmaşık komorbid durumlarını olasılıksal olarak tespit etmek ve düzene sokmak mümkündür.

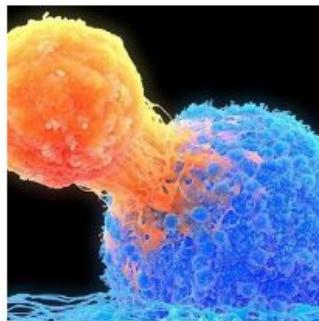


Oncosprint özelinde belirlenmiş sorunlar açısından;

❖ ***65 yaş kanser hastalarının tedavi süreçlerindeki zorlukları aşabilmek için neye ihtiyacımız olurdu?***

- Hastanın klinik durumunun tespitinde kolaylaştırıcı araç ihtiyacı
 - Bütüncül değerlendirme
 - Çoklu ilaç etkileşimleri
- Kısa ve hızlı değerlendirmeler için sistematik yaklaşım ihtiyacı
- Yeni tanı-tedavi yöntemlerine erişimin ihtiyacı
 - Hedefe yönelik doğru tedavi
 - Kişiselleştirilmiş tedavi
- Ülke genelinde kullanılabilecek hızlı ve güvenilir sistem ihtiyacı





DDI Network nedir?

DDI Network,
ileri yaşlardaki kanser hastaları
için geliştirilmiş, tanı ve tedavi
süreçlerinde doktor ve
araştırmacılara yardımcı olmak
için tasarlanmış, bilimsel bilgiye
dayalı bir
web platformudur.

DDI Network ne yapar?

Kanser Biyoinformatiği
Bilgisayar Bilimleri,
Tip
Eczacılık ve Biyoloji altyapısıyla
oluşturulmuş veri
kütüphanelerinden yapay zeka
algoritmaları yardımıyla
ihciyacınıza yönelik bilgileri çeker.

Elde ettiği büyük verileri
olasılıksal programlama dilleri
(PPL) yardımıyla işler, bilimsel
araştırmalarla destekler ve
kullanıma hazır simülasyonlar
halinde sizlere sunar.

Hastalık-Kanser Etkileşim Simülasyonları

Hastanızın sahip olduğu
hastalıkların kanser ile
etkileşiminin ne şekilde
olabileceğini görebileceğiniz
olasılık dağılım senaryoları,
detaylı bir raporlama ile size
sunulur.

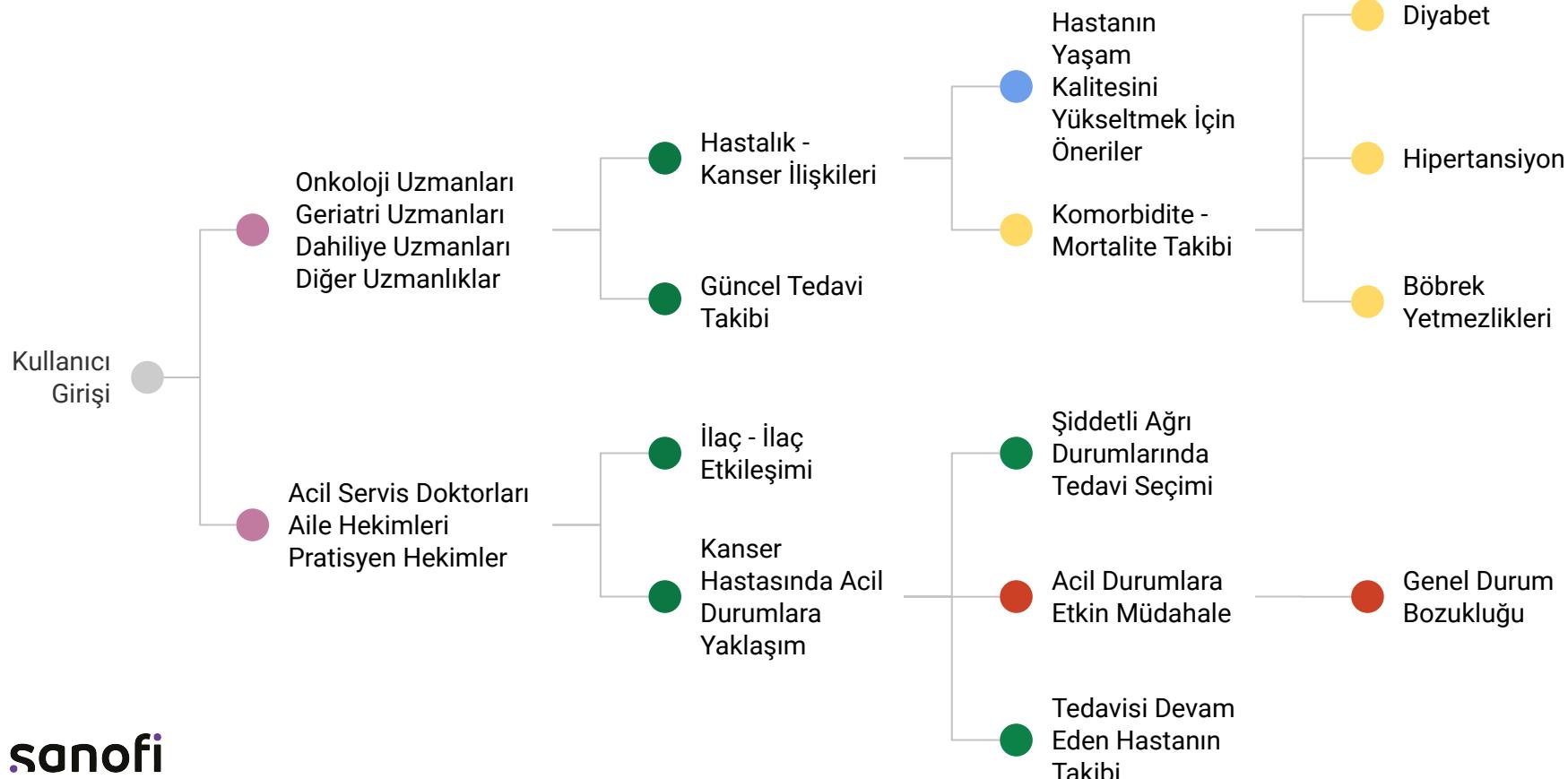
İlaç-Kanser Etkileşim Simülasyonları

Hastanızın kullandığı ilaçların
kanser tedavisinde kullandığınız
ilaçlarla etkileşiminin ne şekilde
olabileceğini görebileceğiniz
olasılık dağılım senaryoları,
detaylı bir raporlama ile size
sunulur.

Kimler/neden ihtiyaç duyabilir?

Kullanıcının İhtiyaçlarına Göre Düzenlenmiş DDI Network Haritası

- Hastaya Özel ve Doktorun ihtiyaçlarına göre kategorizasyon

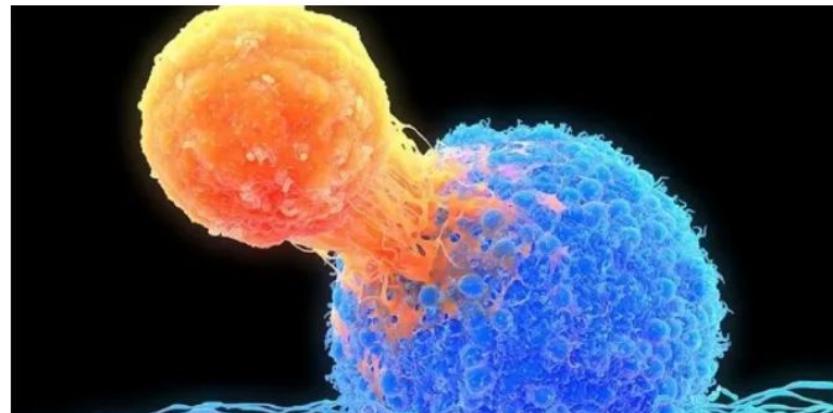


TEDAVİ VE REÇETE TASARIMI İÇİN BİLİMSEL ZEMİNLİ ÖN BİLGİLER



İlaç-Kanser Etkileşim Simülasyonları (Drug - Cancer Interaction Simulations)

Bu ilaçları kullanırsam, bu hasta özelinde hangi semptomlar gelişebilir?



Hastalık-Kanser Etkileşim Simülasyonları (Disease - Cancer Interaction Simulations)

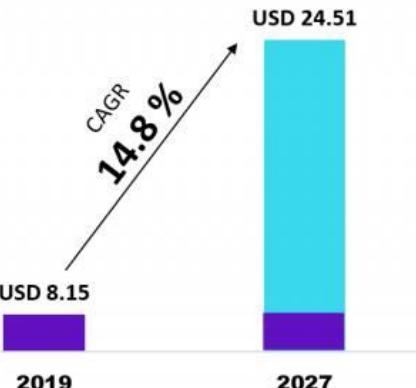
Bu tedavi yöntemlerini izlersem, bu hasta özelinde kanserin seyri nasıl ilerleyebilir?



Pazar Doğrulama

Biyoinformatik büyüyen ve sürdürülebilir bir endüstridir.

Global Bioinformatics Market
Size (USD Bn) 2019-2027



Source: ReportCrux Market Research



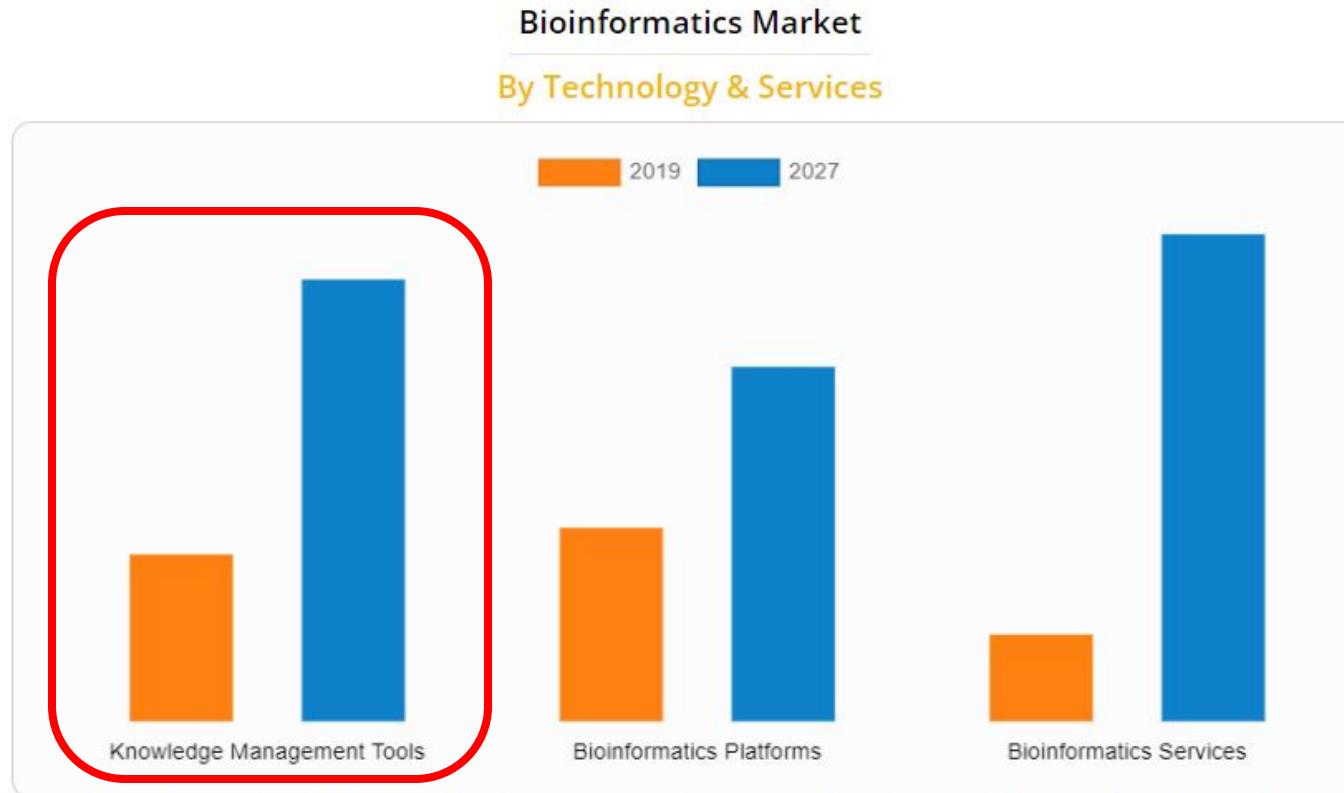
PRECEDENCE
RESEARCH

Oncology
Market
2021 to 2030



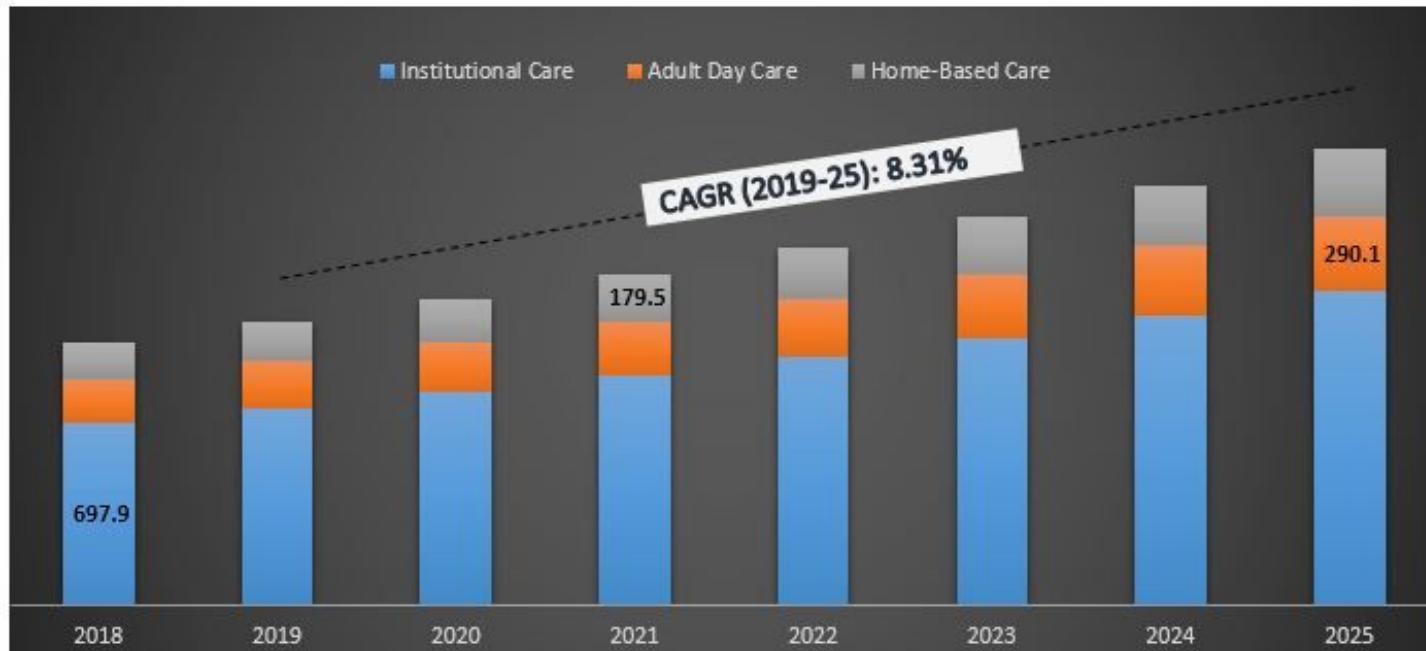
Source: www.precedenceresearch.com

DDI Networks, bilgi yönetim araçları pazarında yer alır.



Bioinformatics Platforms holds the dominant position in 2019 and would continue to maintain the lead over the forecast period.

Kurumsal tedavi ve bakım pazarı yetişkin hastalar için büyümektedir, kurumsal tedavilerde yapılacak iyileştirmelerin pazar payı büyktür.



Elderly Care Service Market: Current Analysis and Forecast 2019-2025

Arayüz Algoritma Şeması



Arayüz Kullanıcı Girdileri

İhtiyaca Yönelik Oluşturulmuş DDI Network Simülasyonları

Kullanıcının Tanımlanması

- Onkolog
- Dahiliye Uzmanı
- Geriatri Uzmanı
- Aile Hekimi
- Acil Doktoru
- Kanser Araştırmacıları

Simülasyon Tanımlanması

- Potansiyel İlaç Etkileşimleri
- Kanser-Hastalık Etkileşimleri
- Kanser Tipinin Genetik Haritası
- Güncel Tedaviler
- Güncel Bilimsel Yayınlar

Hasta Bilgilerinin Tanımlanması

- Hasta yaşı - cinsiyeti
- Eşlik eden kronik hastalıkları
- Sigara/alkol kullanımı
- Düzenli kullanılan ilaçları
- Kanser tipi
- Kanser evresi

İhtiyaca Göre Sonuçlar

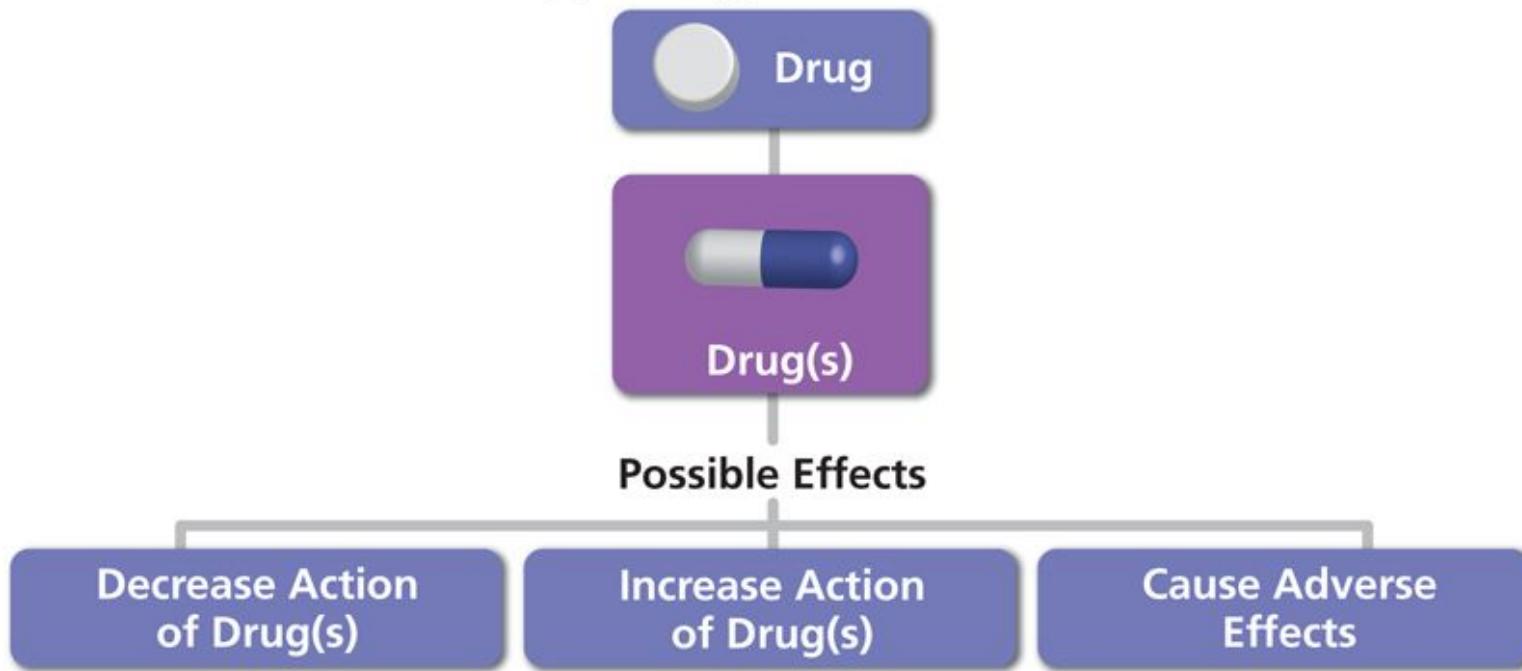
Sonuçların **kullanıcı ihtiyacına** göre sıralanması.

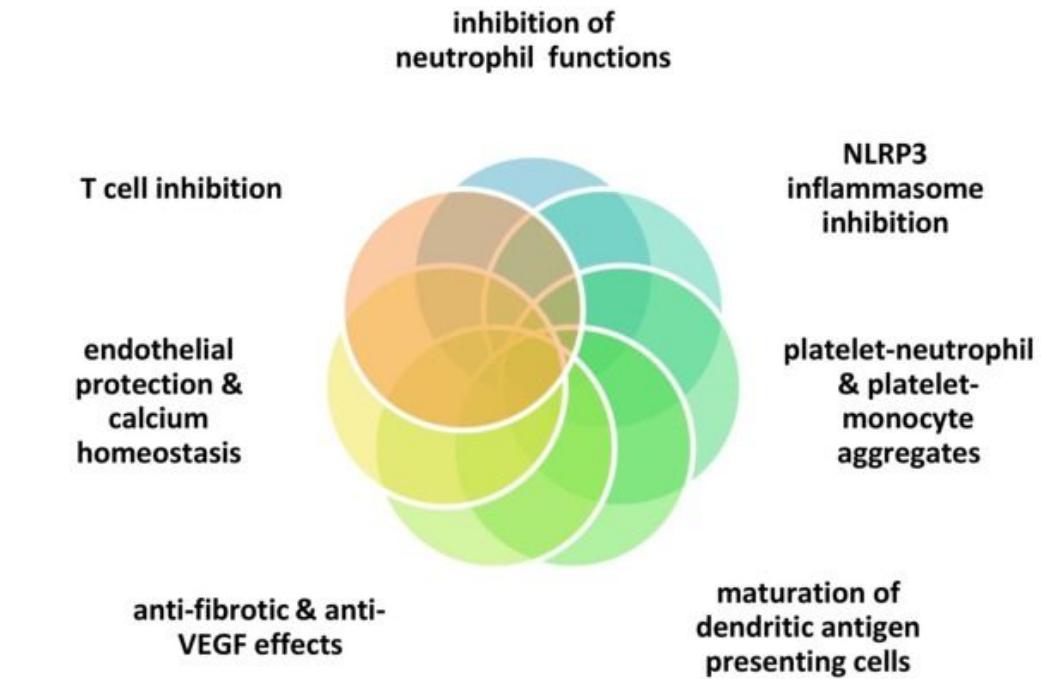
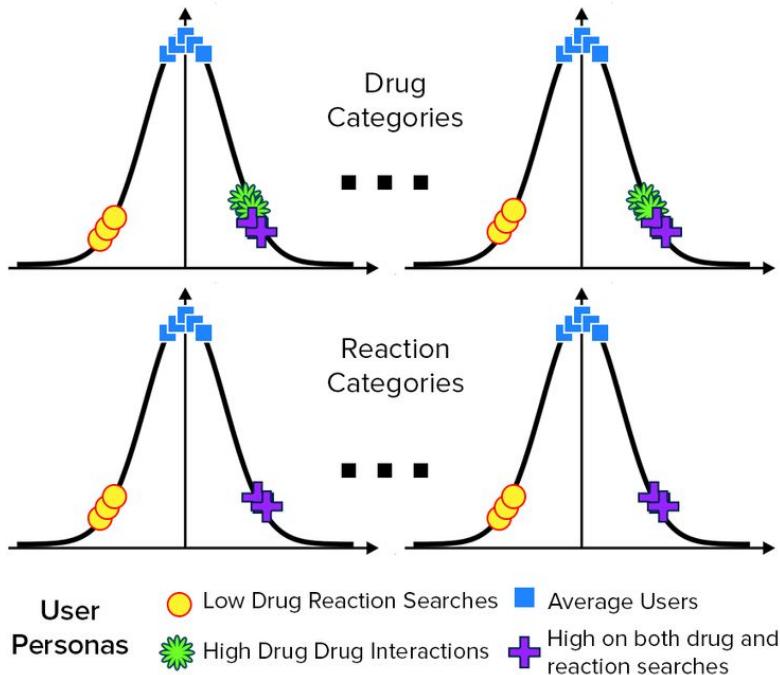
Filtrelemeler dikkate alınarak rapor oluşturulması.

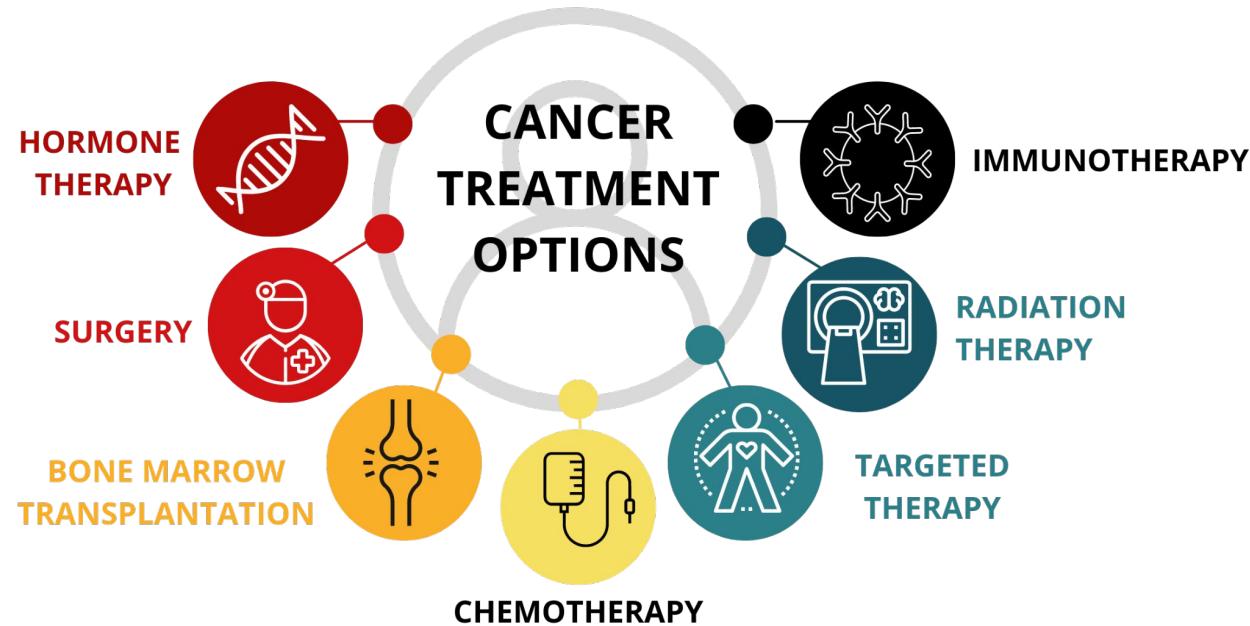


İlaç Etkileşimleri

Drug-Drug Interaction





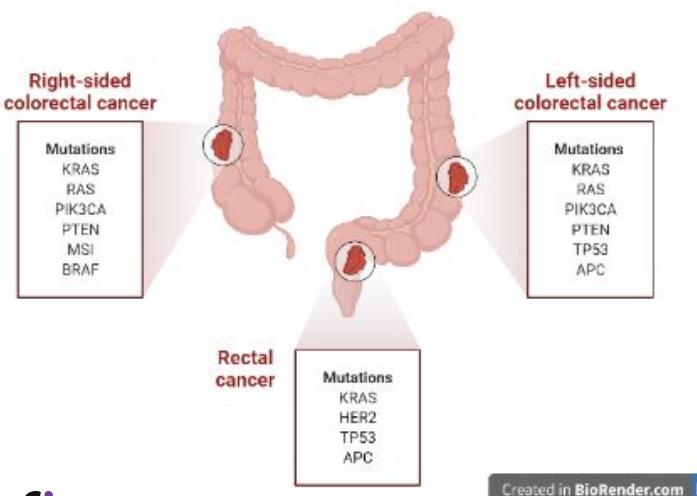


Hastalık-Kanser Etkileşimi

Tip 2 Diyabet & Coleractal Kanser

Tarih

Yaygın Mutasyonlar:



Literatürden:

[nature](#) > [scientific reports](#) > [articles](#) > [article](#)

Open Access | Published: 24 April 2017

Higher risk of colorectal cancer in patients with newly diagnosed diabetes mellitus before the age of colorectal cancer screening initiation

Sander de Kort Ad A. M. Mascline, Silvia Sanduleanu, Matty P. Weijenberg, Myrthe P. P. van Herk-Sukel, Nico J. J. Oldenhof, Joop P. W. van den Bergh, Harm R. Haak & Maryska L. Janssen-Heijnen

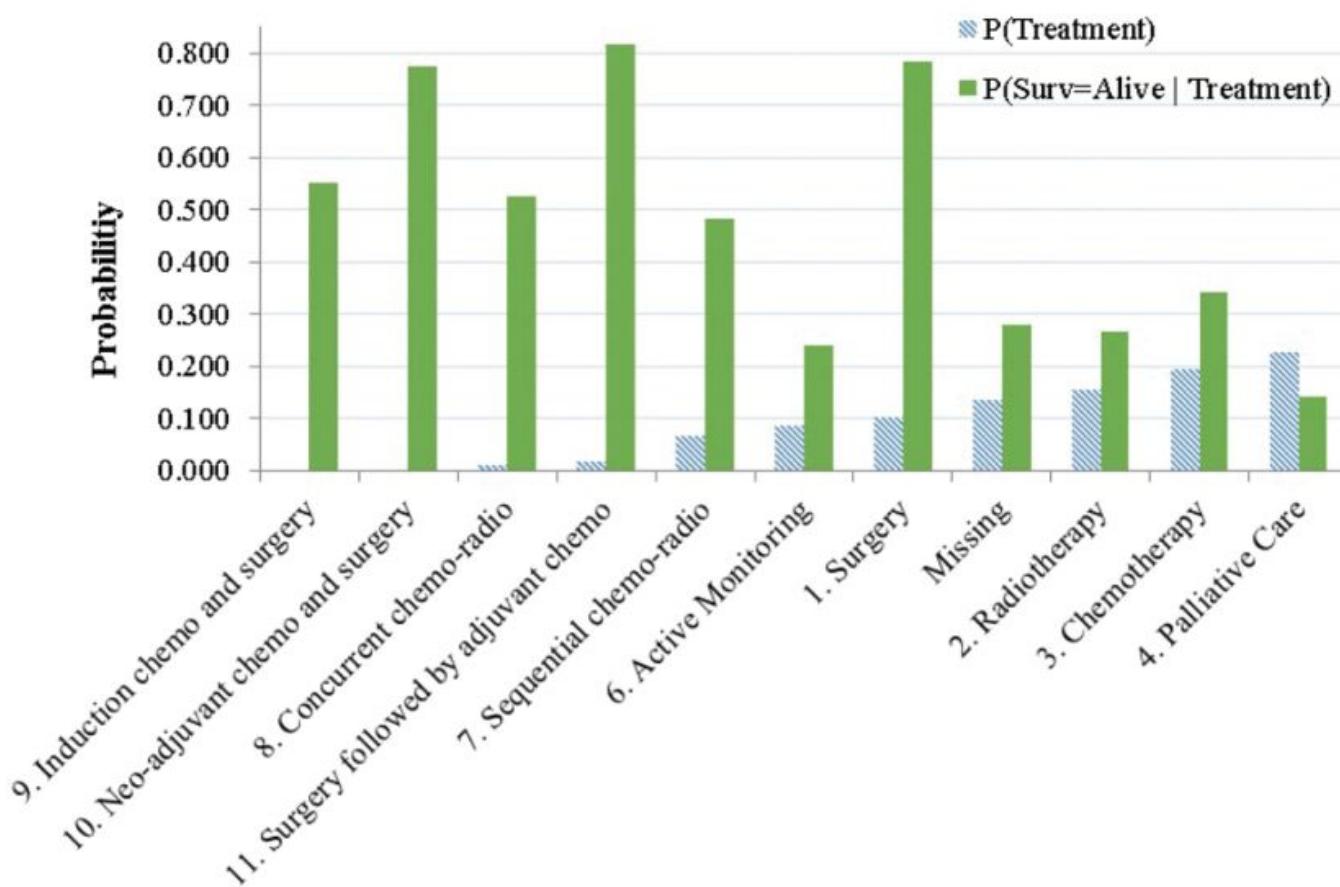
[Scientific Reports](#) 7, Article number: 46527 (2017) | [Cite this article](#)

2974 Accesses | 40 Citations | 4 Altmetric | [Metrics](#)

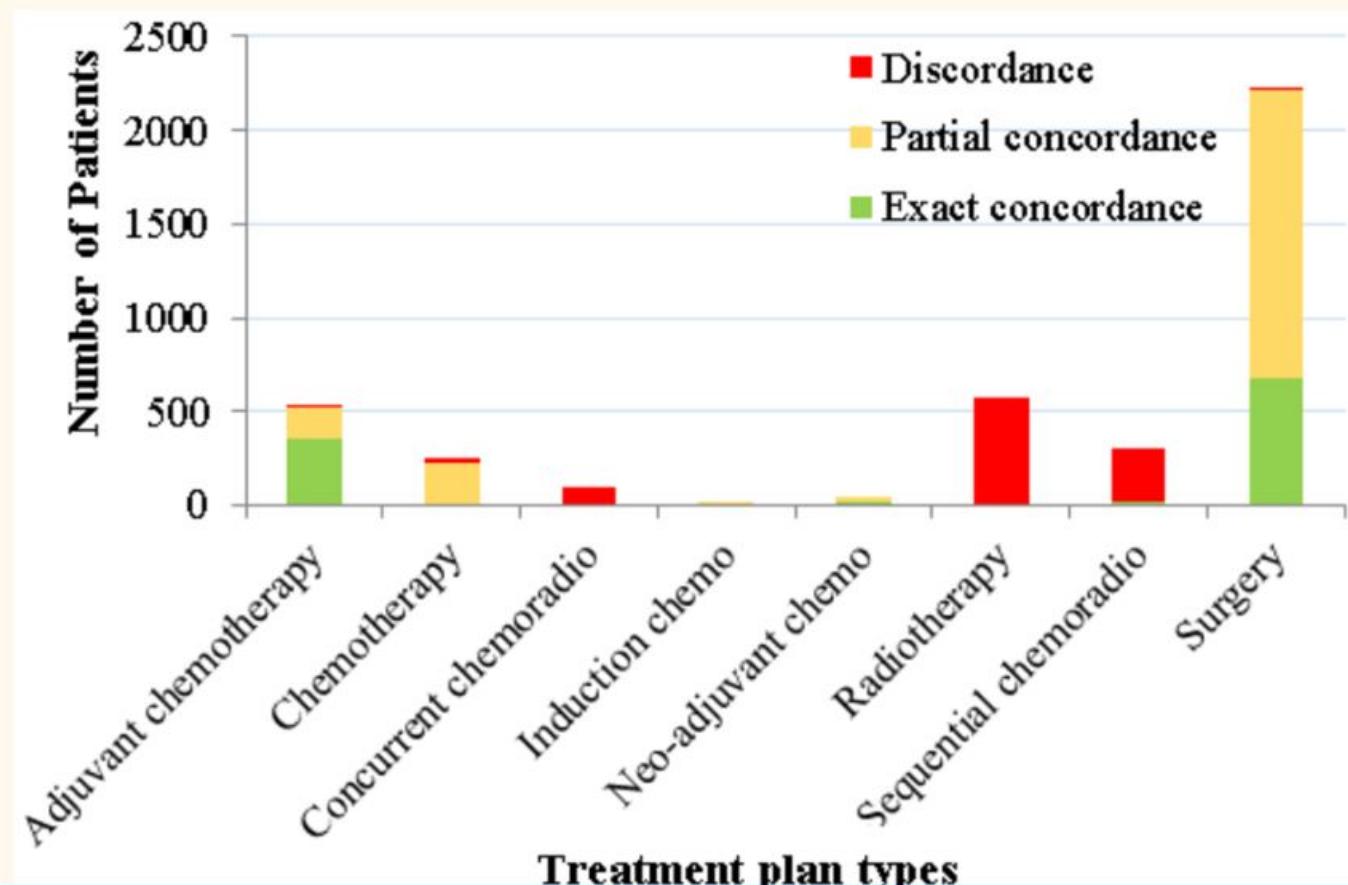
Abstract

<https://www.nature.com/articles/srep46527#Sec3> is associated with greater risk for colorectal cancer (CRC).

Hesaplanan şekilde tedavi planı olasılıkları:

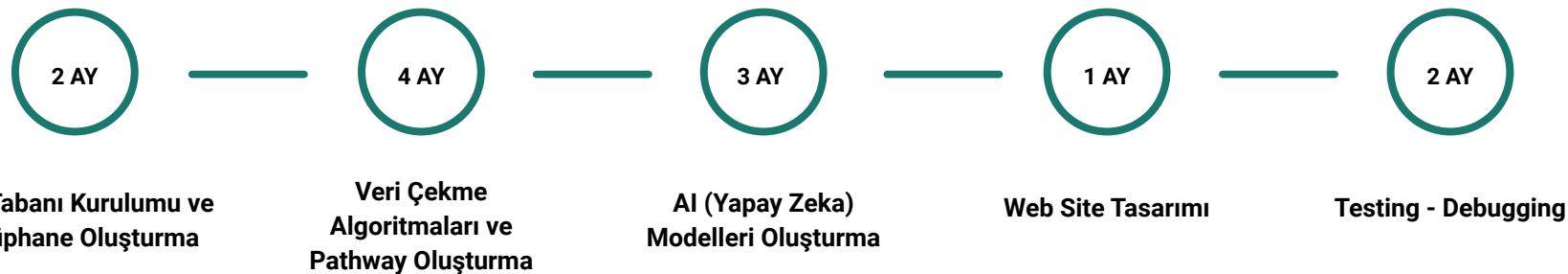


Önerilen ve kaydedilen tedavi planları arasındaki tam ve kısmi uyum.



Süreç: 12 AY

Bütçe: 500.000₺



Uygulama geliştirme sürecinde **sahada aktif çalışan hekimler** ve **araştırmacılarla** sistemi, klinik ihtiyaçlara göre şekillendiriceğiz.



DDI network açık kaynak kodlu yapısıyla
bir çok sisteme kolayca entegre edilebilir.

Ayrıca hastane sistemlerine entegre edilmeden de website veya mobil uygulamadan
kolayca erişilebilir.



Teşekkür Ederiz

DDI Network

+65 kanser hastalarının tedavi planlamasına yönelik,
yapay zeka ile İlaç-İlaç ve Kanser-Hastalık
etkileşim simülasyonları yapan
biyoinformatik arayüzü

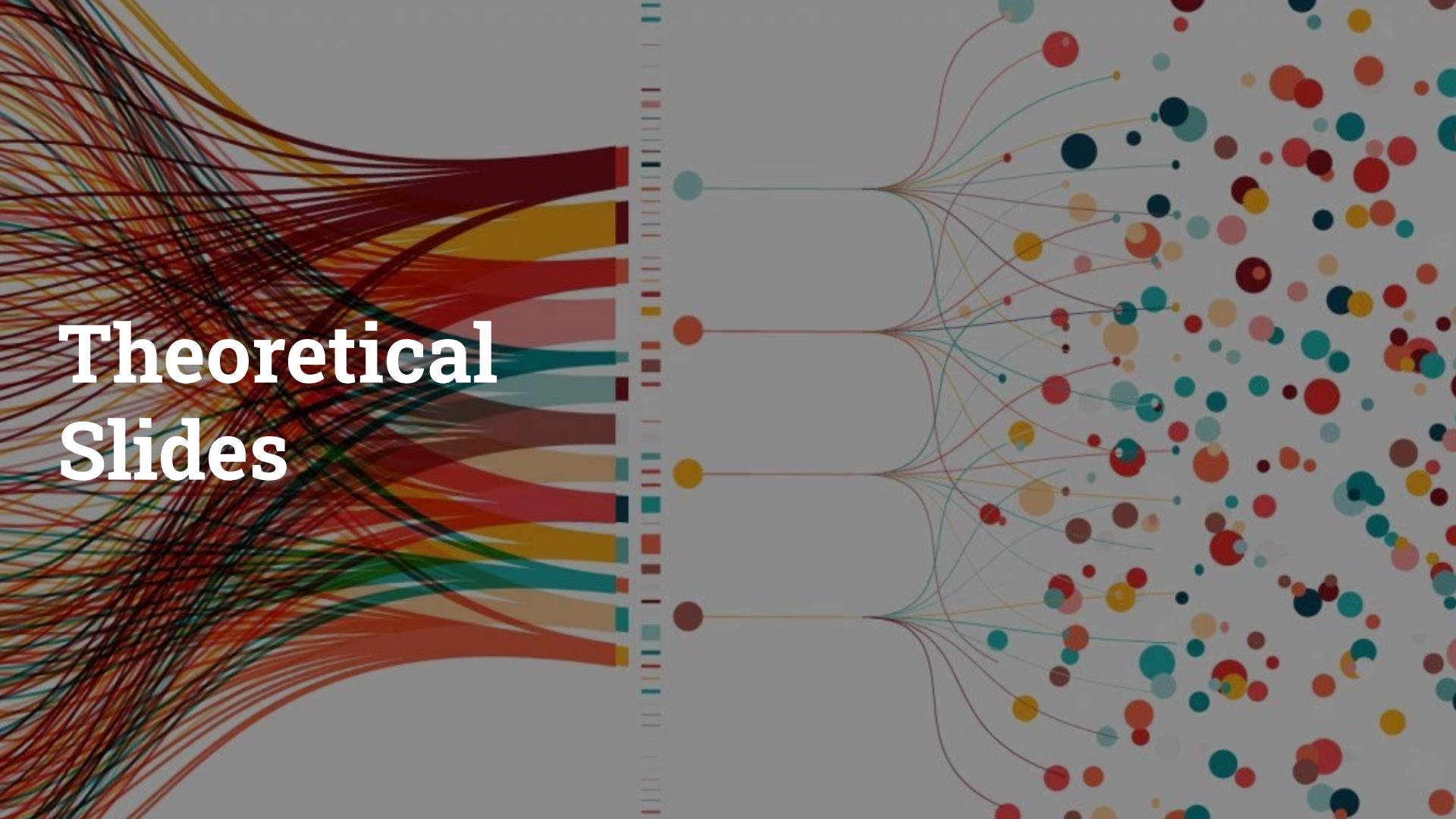


BİLİŞİM VADİSİ

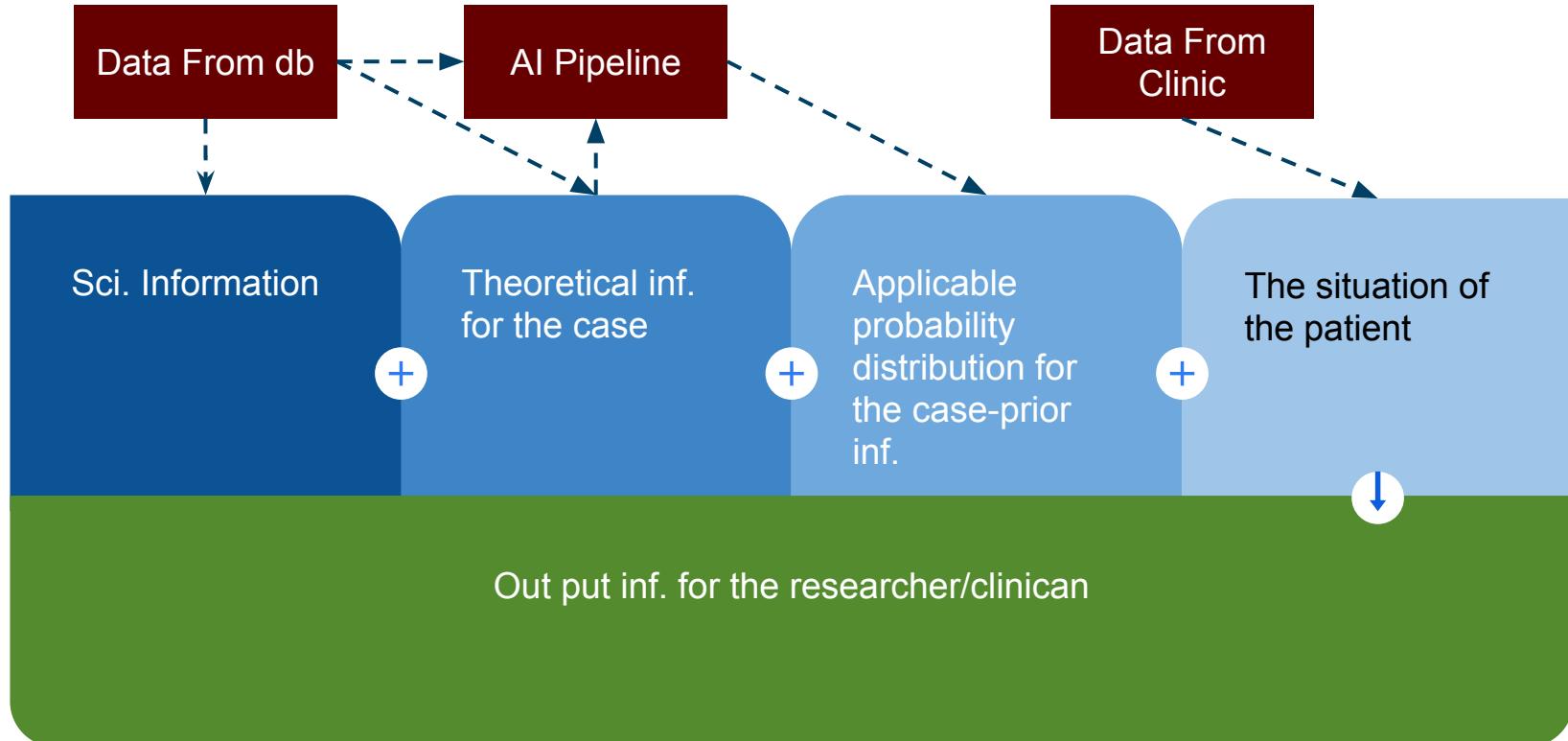


sanofi

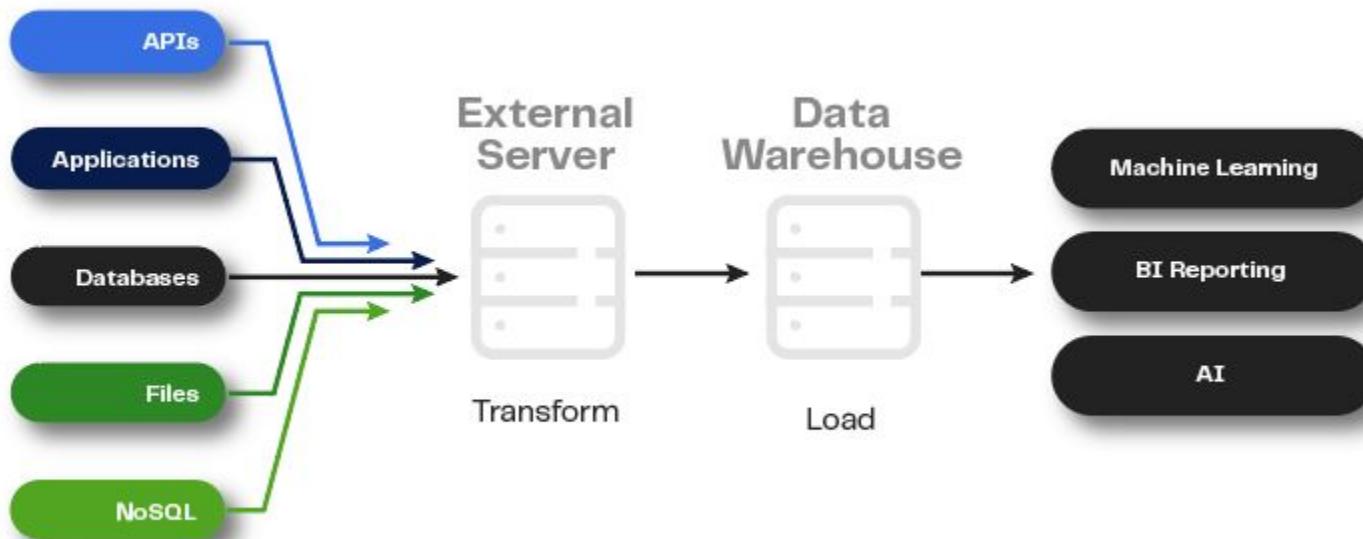
Theoretical Slides

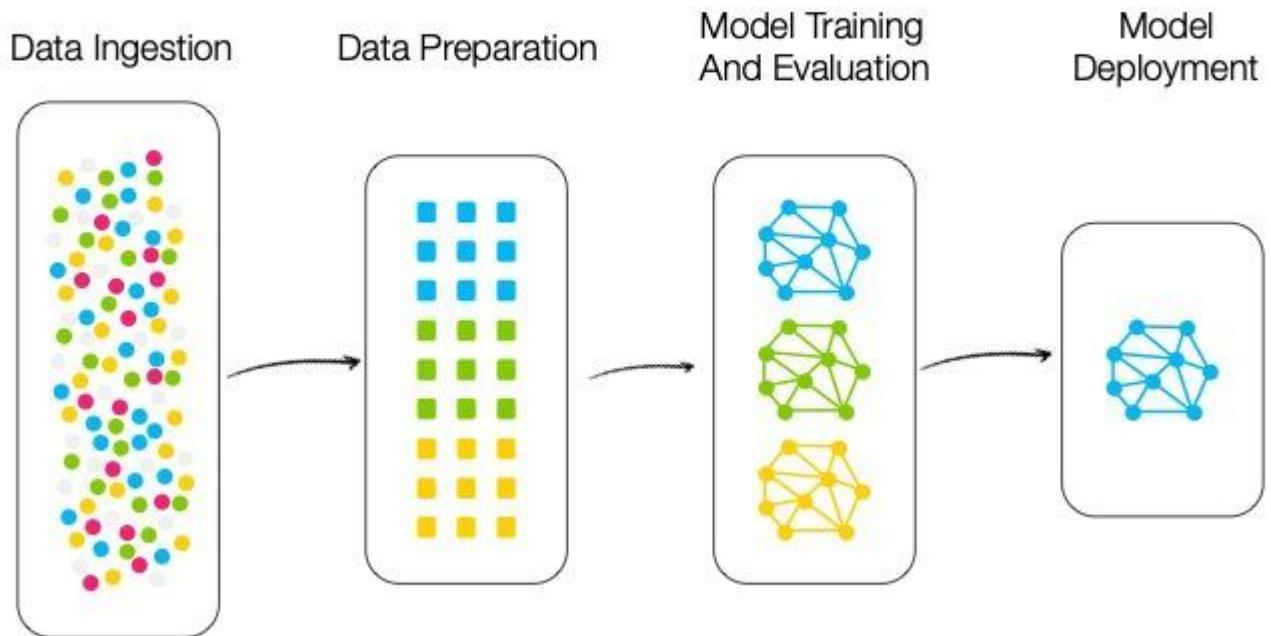


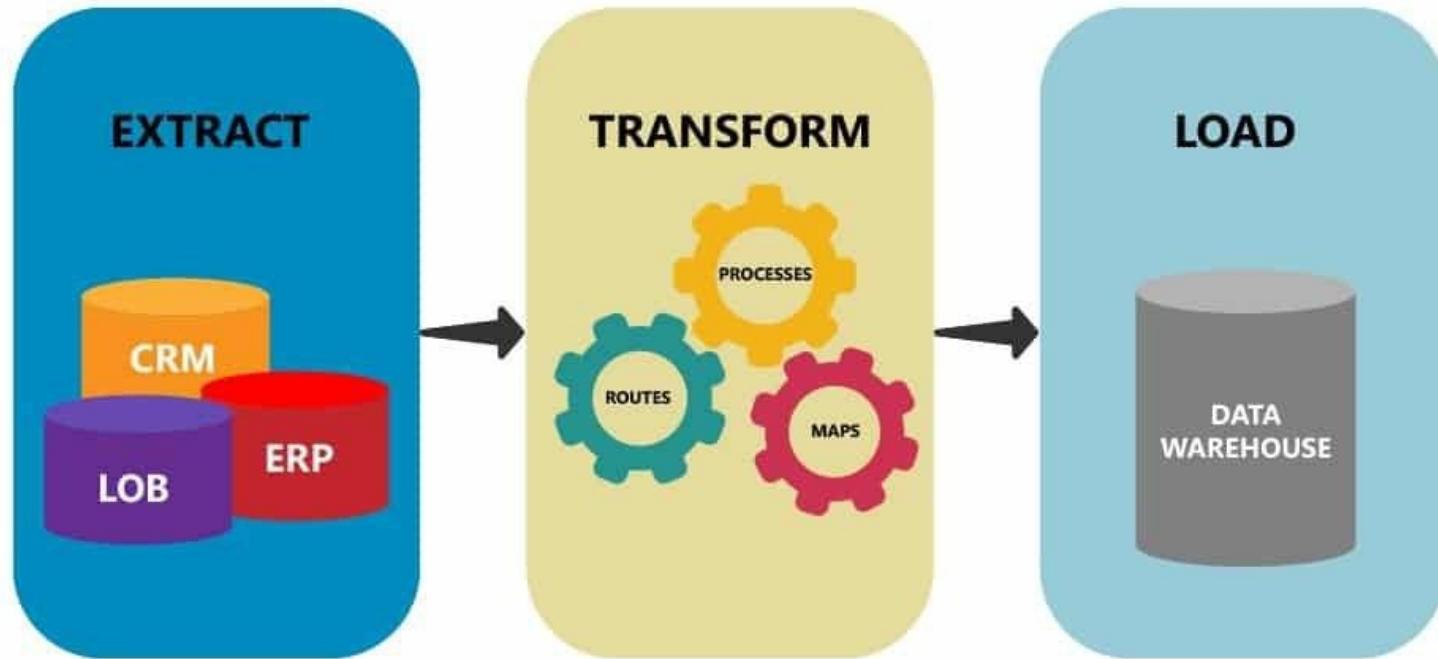
Decision - Support Mechanism: As prob. distribution



Extract & Process Needed Data



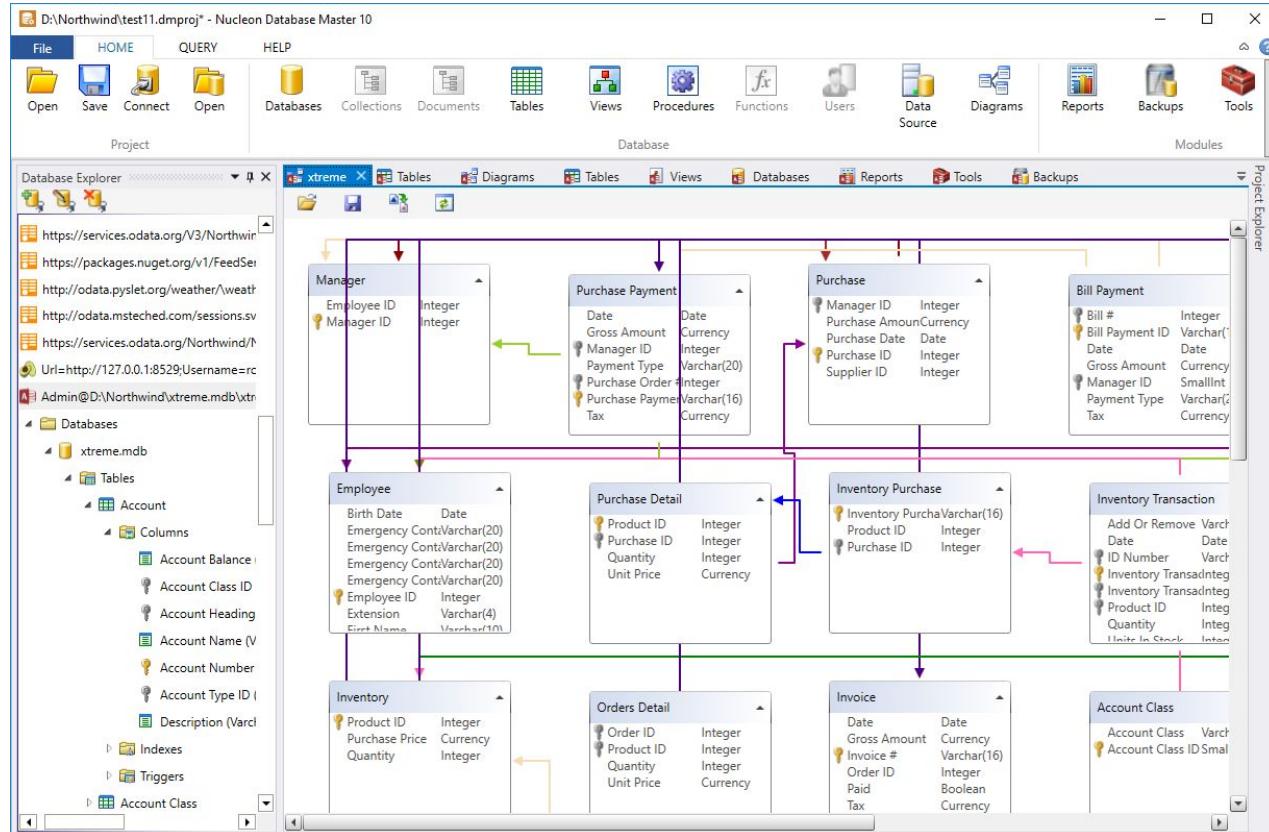




ETL - Extract, Transform, Load



Databases allow working by keeping very different data in one hand and switching between data



A database for every aspects of the cancer - Aging Relation -
Firebase for demo - Google Cloud - Sql for product



Many Databases for Cancer

The screenshot shows the cBioPortal interface. At the top, there is a navigation bar with links to Data Sets, Web API, R/MATLAB, Tutorials/Webinars, and FAQ. A green banner below the navigation bar states "The cBioPortal team is hiring a software engineer! /". Below the banner, there are three tabs: Query, Quick Search Beta, and Download. Under "Select Studies for Visualization & Analysis:", there is a table with the following data:

Study Type	Count
PanCancer Studies	10
Pediatric Cancer Studies	13
Immunogenomic Studies	8
Cell lines	3

Under "PanCancer Studies", there is a "Quick select:" dropdown containing "TCGA PanCancer Atlas Studies" and a "Curated set of nc" option. Below this, there is a list of studies:

- MSK-IMPACT Clinical Sequencing Cohort (MSKCC, Nat Med 2011)
- Metastatic Solid Cancers (UMich, Nature 2017)
- MSS Mixed Solid Tumors (Broad/Dana-Farber, Nat Genet 2018)
- SUMMIT - Neratinib Basket Study (Multi-Institute, Nature 2018)

The screenshot shows the NCRAS National Cancer Data Repository website. At the top, there is a navigation bar with links to About NCRAS, Events, Collecting & Using Data, Publications, Cancer Information Tools, Cancer Type & Topic Specific Work, and Local Intelligence. The main content area has a large "ncras" logo and the text "National Cancer Registration and Analysis Service". Below the logo, there is a section titled "COLLECTING AND USING DATA" with a sub-section titled "Data Collection" containing the following items:

- Cancer Outcomes and Services Dataset (COSD)
- Rapid Cancer Registration Dataset (RCRD)
- National Radiotherapy Dataset (RTDS)

On the right side, there is a section titled "National Cancer Data Repository" with the following text:

The specification for the 2011 NCDR has been sent to Public Health England (PHE) Knowledge and Intelligence Teams (KITs) and Celtic Countries. A project plan is to be released shortly.

The 1990 - 2010 England NCDR Analysis Dataset brings together data from each England Cancer Registry period of 1990 to 2010.

The data consists of Tumour level records submitted to Office of National Statistics (ONS) by the English Registries together with a further sub-set of data covering additional data fields required for analysis purposes.

The NCDR is held in a central location and is accessible by each of the English cancer registries in line with NCRAS's data access policies.

The screenshot shows the COSMIC Catalogue Of Somatic Mutations In Cancer website. At the top, there is a logo with the text "COSMIC Catalogue Of Somatic Mutations In Cancer". Below the logo, there is a navigation bar with tabs for Projects ▼, Data ▼, Tools ▼, News ▼, Help ▼, About ▼, and Genome. At the bottom, there is a footer with the text "DDI Network".

Table I

Cancer databases.

Database	Description	URL
Comprehensive cancer projects		
CGP	Cancer Genome Project	http://www.sanger.ac.uk/research/projects/cancergenome/
CPTAC	Clinical Proteomic Tumor Analysis Consortium	http://proteomics.cancer.gov/programs/cptacnetwork
ICGC	International Cancer Genome Consortium	https://www.icgc.org/
TCGA	The Cancer Genome Atlas	http://cancergenome.nih.gov/
Resources		
BioMutu	A framework for	https://hive.biochemistry.gwu.edu/tools/biomuta/biomuta.php

Human cancer databases (Review) - PMC

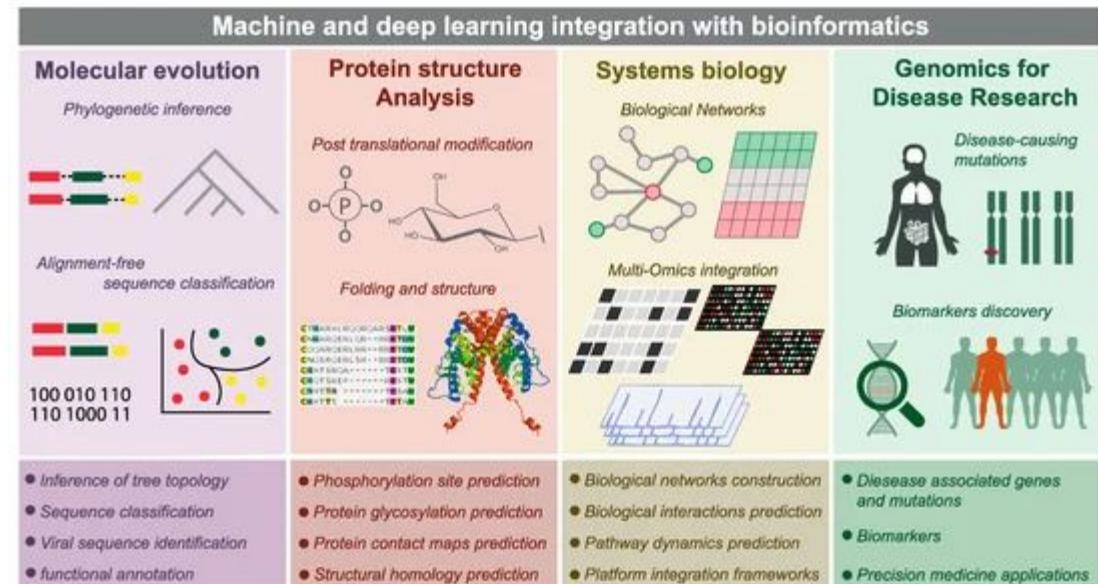
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4254674/>

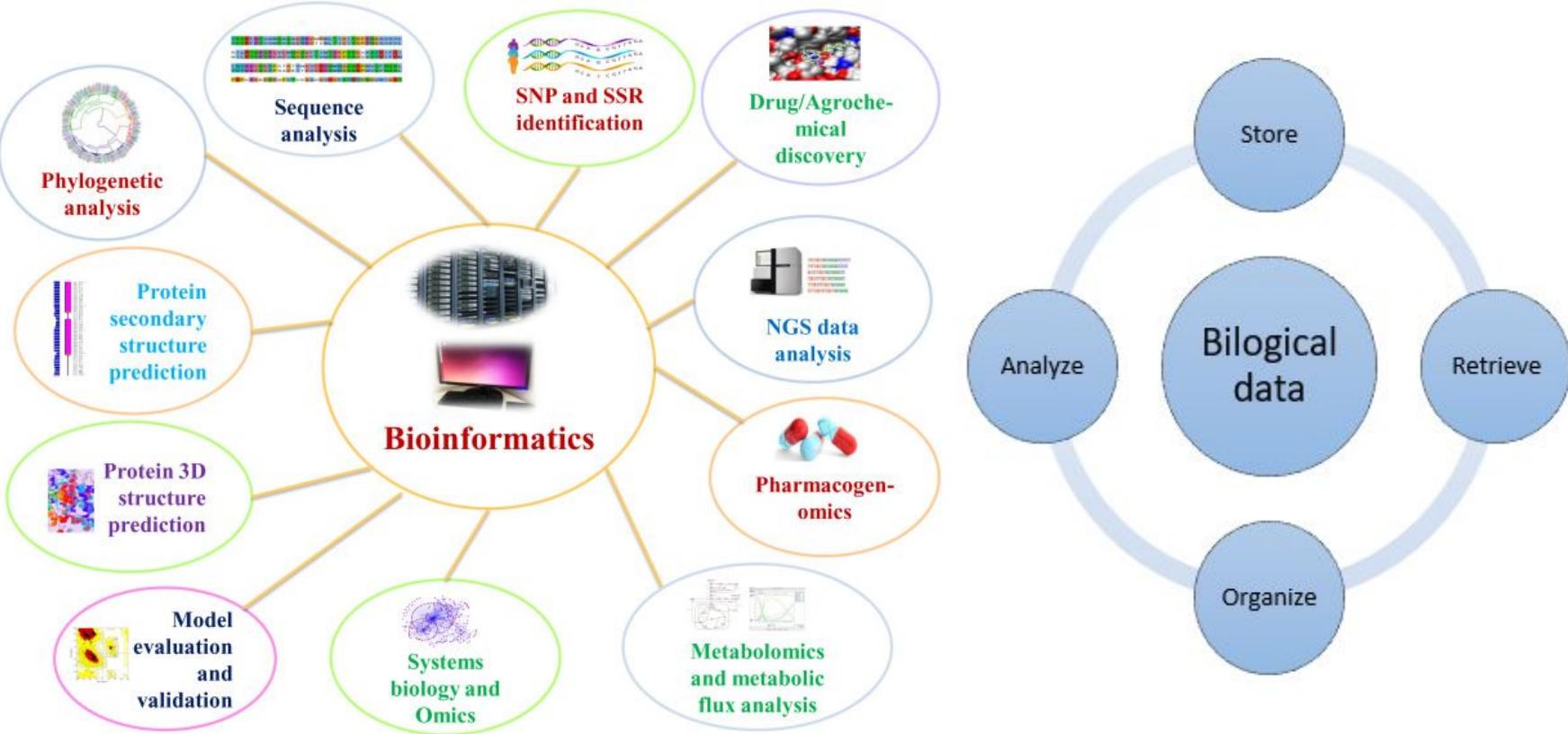
Methods such as Machine learning, Artificial intelligence algorithms, Neural Networks, Bayesian networks are also used in bioinformatics studies and provide advantages in the analysis of biological systems.

Supervised learning

	Frequently used algorithms for biomedical research	Example usage (data type)
Machine learning	SVM	• Cancer vs healthy classification (gene expression)
	KNN	• Multiclass tissue classification (gene expression)
	Regression	• Genome-wide association analysis (SNP)
	Random forest	• Pathway-based classification (gene expression, SNP)
Deep learning	CNN	• Protein secondary structure prediction (amino acid sequence)
	RNN	• Sequence similarity prediction (nucleotide sequence)
Clustering	Hierarchical	• Protein family clustering (amino acid sequence)
	K-means	• Clustering genes by chromosomes (gene expression)
	PCA	• Classification of outliers (gene expression)
dimensionality reduction	tSNE	• Data visualization (single cell RNA-sequencing)
	NMF	• Clustering gene expression profiles (gene expression)

<https://www.mdpi.com/1422-0067/22/6/2903/htm>

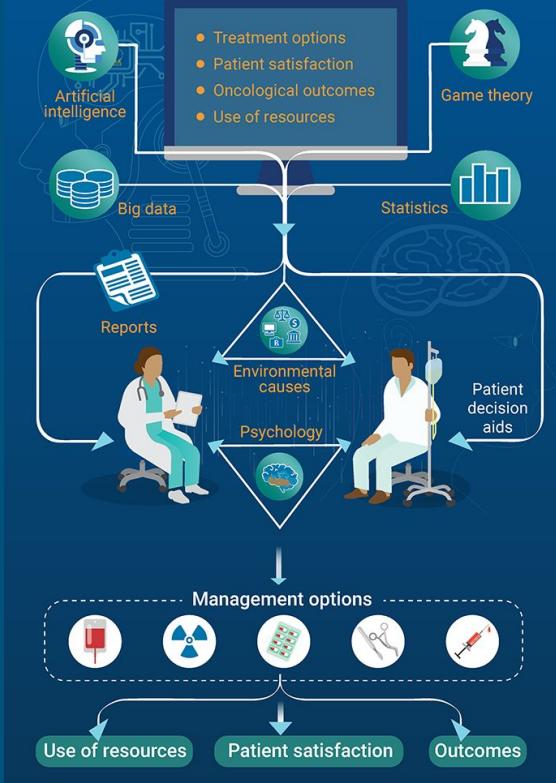




- hypothesis development (pre lab/ pre clinics)
- analyzing available data from the clinic
- meta-analysis of data found in literature + online dbs

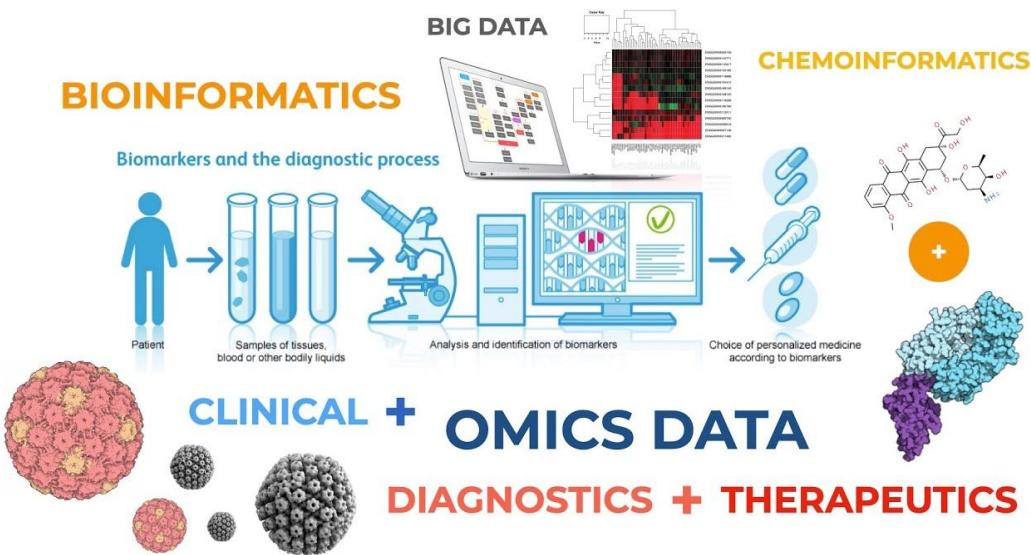
What influences decision making in oncology?

Multifactorial decision support systems (DSS)



Decision making should be patient centric. Informatics tools can help both patients and physicians make better decisions.

Personalized Medicine



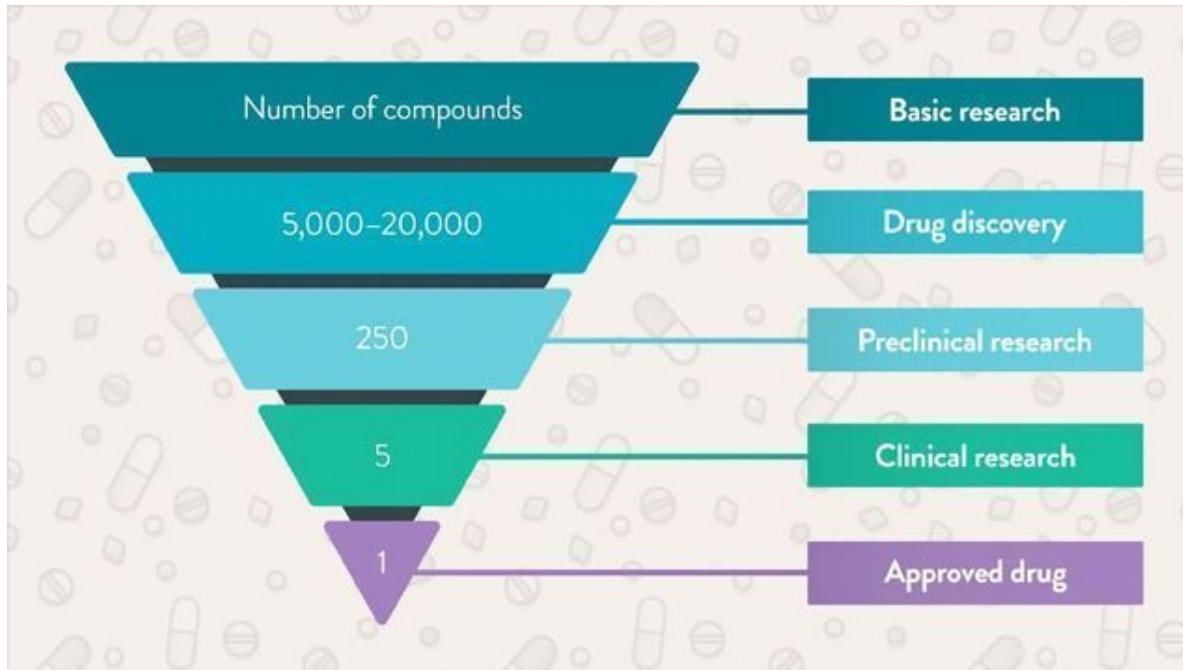
Ana T. Freitas
Arcadi Navarro (Eds.)

LNBI 6620

Bioinformatics for Personalized Medicine

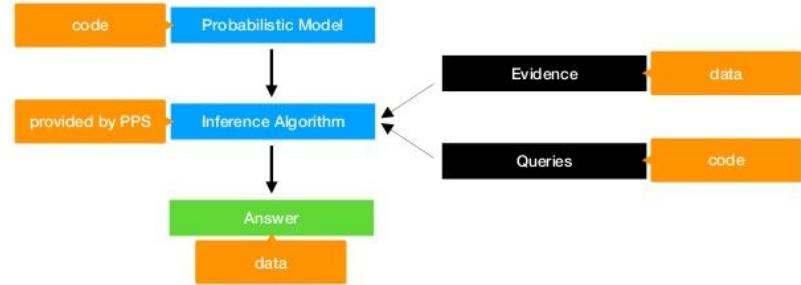
10th Spanish Symposium, JBI 2010
Torremolinos, Spain, October 2010
Revised Selected Papers

Computational biology enables possible treatments, drugs, processes and steps to be reduced with the help of intensive and high calculations, so the odds can be lowered from 10,000 to 5, as in drug research.



Input → **BLACK BOX** → Output

- . The schematic representation of the deterministic programming (*Google Photos*).



Probabilistic **Programming** System

The schematic representation of the probabilistic programming system (*Blum-Oeste, 2017*)

The Posterior

The Evidence

The Prior

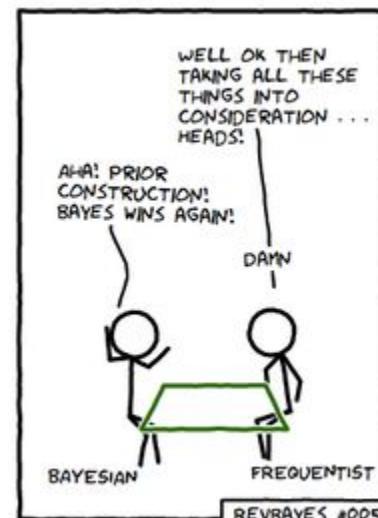
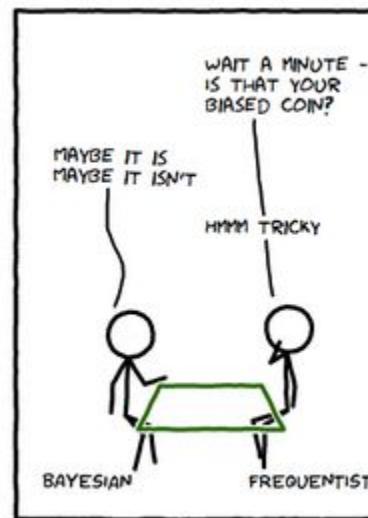
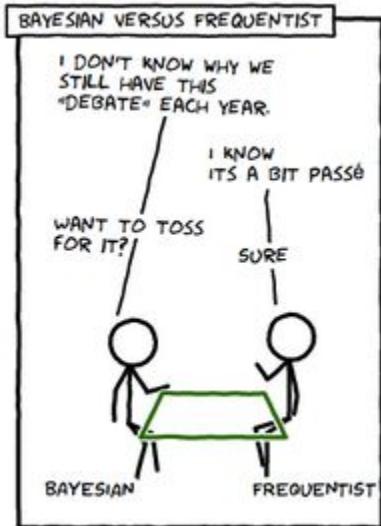
The probability of getting this evidence if this hypothesis were true

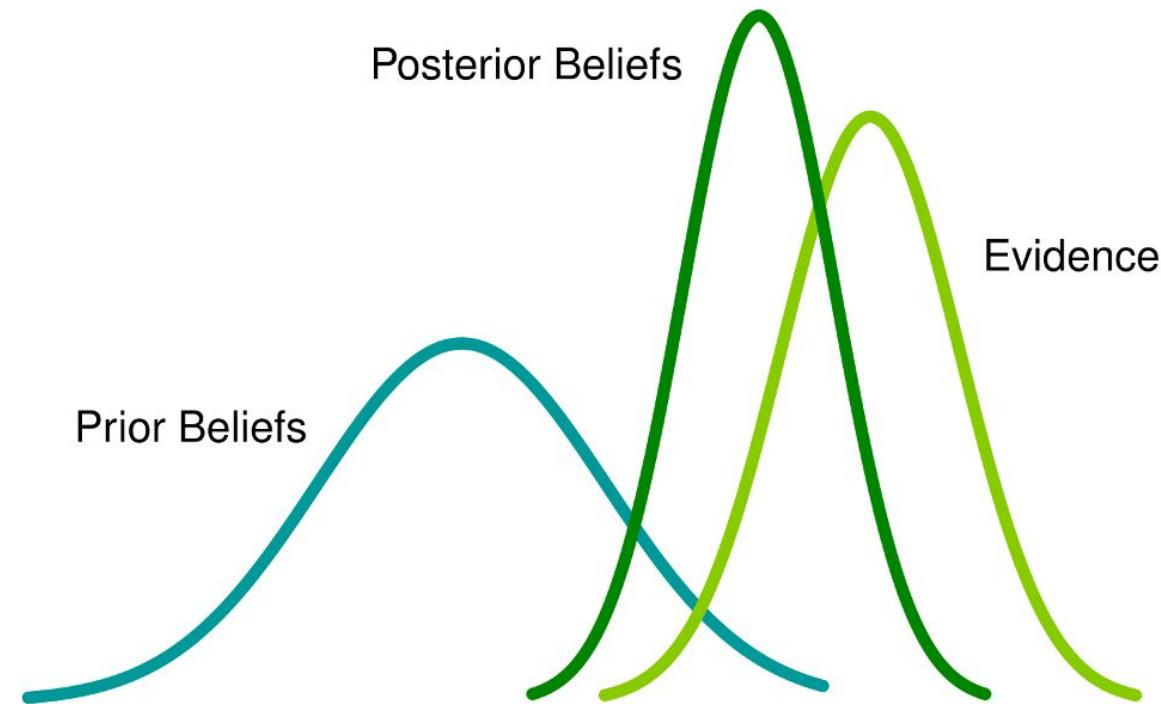
The probability of H being true, before gathering evidence

$$P(H|E) = \frac{P(H|E) P(H)}{P(E)}$$

The probability that the hypothesis (H) is true given the evidence (E)

The marginal probability of the evidence (Prob of E over all possibilities)





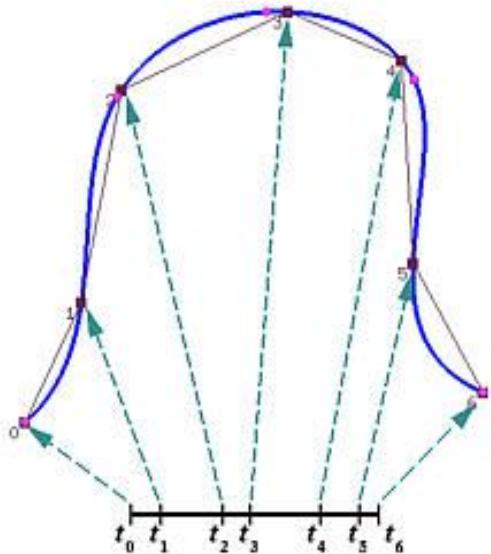


Figure 25. Representation of parameter selection (*Parameter Selection Overview, no-date*).