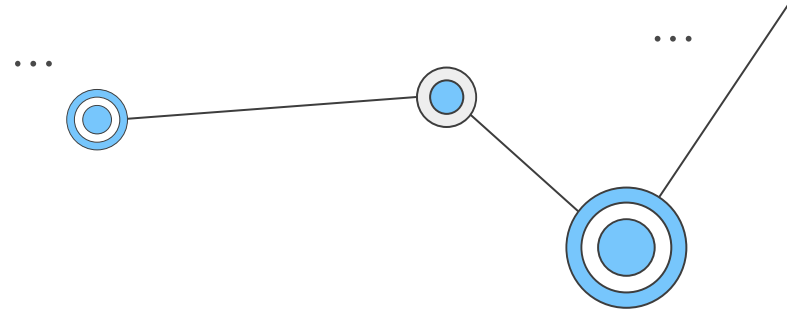
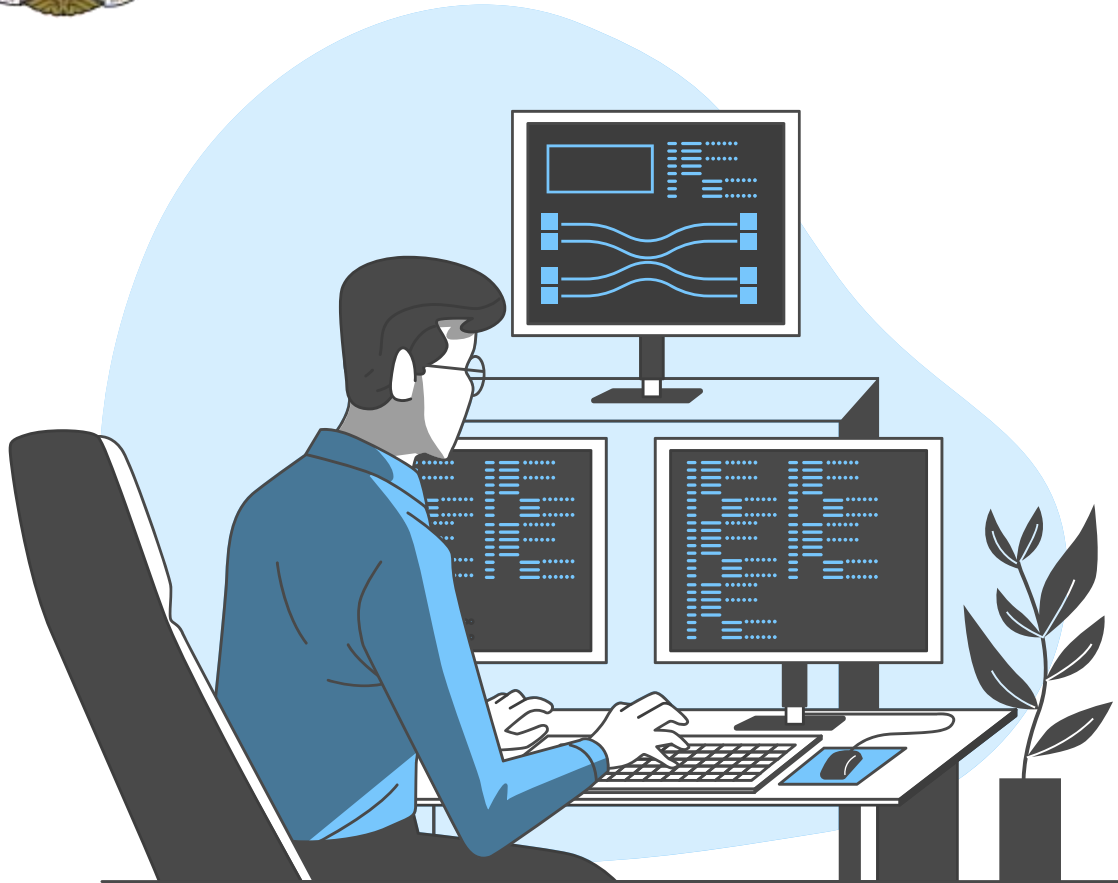




KULIAH TAMU  
Fakultas Farmasi  
Universitas Andalas



# Introduction to Pharmacoinformatics

“Masa depan Farmasi adalah  
digitalisasi”

Prof. apt. Nasrul Wathoni, Ph.D  
10 Juni 2023



**Universitas  
Padjadjaran**



Materi hari ini scan barcode atau di  
<https://nazroel.id>

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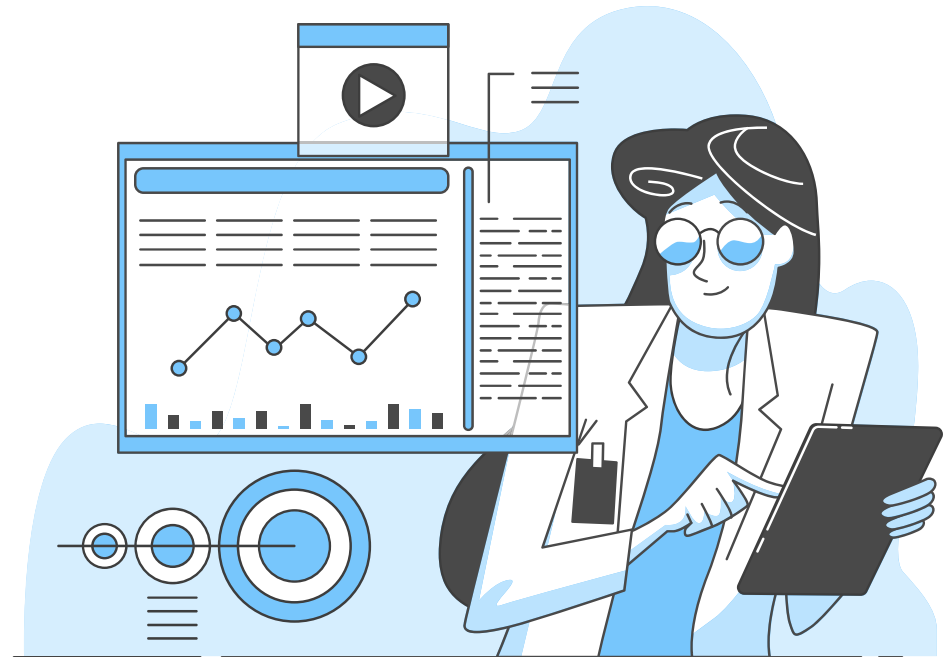
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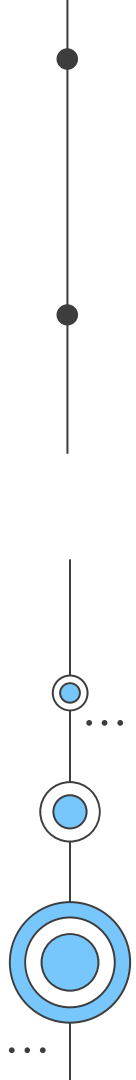




# 01

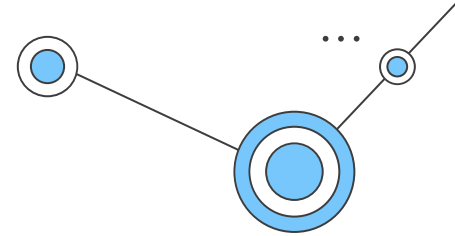
## The future of pharmacy?

Digitalization



# Pekerjaan Kefarmasian

(PP 51 Th 2009)



Pekerjaan Kefarmasian adalah pembuatan termasuk pengendalian mutu Sediaan Farmasi, pengamanan, pengadaan, penyimpanan dan pendistribusi atau penyaluran obat, pengelolaan obat, pelayanan obat atas resep dokter, pelayanan informasi obat, serta pengembangan obat, bahan obat dan obat tradisional.



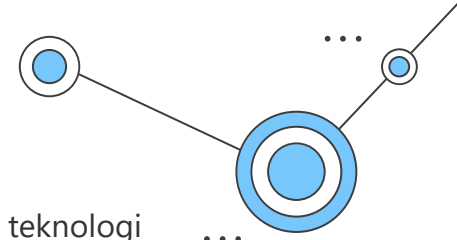
- Pekerjaan Kefarmasian dalam Pengadaan Sediaan Farmasi;
- Pekerjaan Kefarmasian dalam Produksi Sediaan Farmasi;
- Pekerjaan Kefarmasian dalam Distribusi atau Penyaluran Sediaan Farmasi; dan
- Pekerjaan Kefarmasian dalam Pelayanan Sediaan Farmasi.



The Pharmacists' Patient Care Process (JCPP, 2014).

# The Future of Pharmacy is Digital

(Drug Topics Journal, Drug Topics May 2022, Volume 166, Issue 05)



“Kita perlu menjauh dari model berbasis produk menuju fokus pada layanan yang diberdayakan oleh teknologi digital, bertemu pasien di mana pun mereka berada, dan menerapkan mentalitas yang mengutamakan konsumen. Ini adalah masa depan bagaimana kami akan memberikan perawatan bagi pasien.” Timothy Aungst, PharmD, Associate Professor of Pharmacy Practice di Massachusetts College of Pharmacy and Health Sciences

## Regulating Mobile Health

Unlike medications, which fall solely under the governance of the FDA, mobile health apps can be subject to laws put forth by the FDA, Federal Trade Commission (FTC), or Office for Civil Rights (OCR).<sup>2</sup> Read on to learn more about 3 laws that apply to mobile health apps.

### 1. Health Insurance Portability and Accountability Act (HIPAA)

Within the US Department of Health and Human Services, OCR enforces HIPAA rules that protect privacy and security of specific health information.

### 2. Federal Food, Drug, and Cosmetic Act (FD&C Act)

The FDA is the agency responsible for enforcing this act, which regulates safety and effectiveness of medical devices, including certain mobile medical apps. The regulatory focus here is on a “subset of health apps that pose a high risk if they don’t work as intended.”<sup>3</sup>

### 3. Federal Trade Commission Act (FTC Act)

The FTC Act, enforced by the FTC, “prohibits deceptive or unfair acts or practices in or affecting commerce,” including acts relating to privacy, data security, and false or misleading safety or performance claims. In addition, the FTC Health Breach Notification Rule states that certain businesses must provide notifications to affected parties after breaches of personal health information.

In 2016, the FTC published a mobile health apps interactive tool to help app developers determine which of these laws might apply to their creations. To view the tool, scan the QR code.

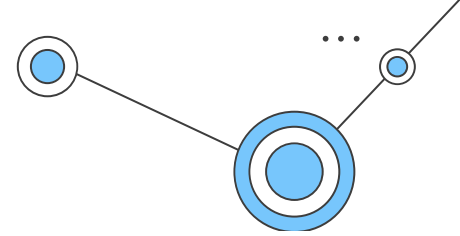


Bidang kesehatan digital mencakup berbagai teknologi, pendekatan, audiens, dan penggunaan yang saling terkait::

1. platform untuk sistem perawatan kesehatan, klinik, dan pengaturan perusahaan lainnya, termasuk apotek
2. platform teknologi dan sistem pendukung untuk dokter dan staf pendukung
3. produk terkait pasien yang menangkap, menyimpan, atau mengirimkan data kesehatan
4. produk untuk mendiagnosis, memandu diagnosis, atau memantau pasien secara langsung
5. produk yang memberikan intervensi medis dan terapi

# Pharmacist's evolving role

(Deloitte Health Care, 2020)



Future pharmacists may need to specialize ...

## Digital

Help patients and providers to select, implement, and manage digital therapeutics and nondrug solutions (such as food) that will meet their needs

## Medical

Specialize in the treatment and management of complex diseases and poly-chronic patients with a deep understanding of genetics

## Behavioral

Focus on mental health and necessary behavioral changes needed to stay compliant and address social determinants of health (SDH)

... to meet patients where they are



Virtually

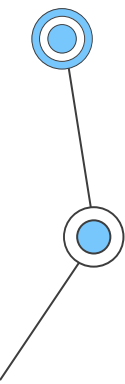
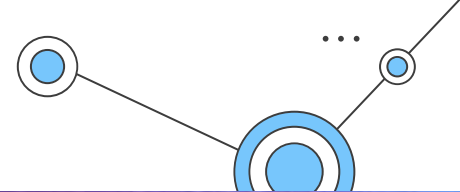


Medical centers



In the home

# The future of pharmacy

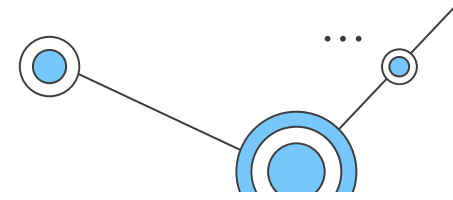




# Concept of the Future of Pharmacy

(Divante Innovation Lab, 2020)





# Pharmacy of the Future: a customer-centered online pharmacy concept

(Divante Innovation Lab, 2020)



## Meet Anna.

Anna is a 30-year-old call center employee with diabetes. Each day she has to check her blood sugar level, eat balanced meals, and take the insulin upon which she is dependent.

Anna recently caught a cold.



How does it work?  
**Anna goes to the doctor.**

The POTF app, integrated with the medical center system, tells the doctor all details of her existing diabetes treatment and helps to pick the right drugs for the cold. The new treatment is saved in the app.

Based on the following technologies:  
 Microsoft / Apple / Amazon for POTF Health Cloud



How does it work?  
**On the way home, Anna goes to the pharmacy store.**

Anna buys the prescribed drugs. The store's app, which is signed with the pharmacy's own system, updates the patient's drug supply along with the quantity and best before date.

The queue is short as other patients pick up their orders from the vending machine.

Based on the following technologies:  
 Microsoft Pharmacy Gateway / Drug release  
 Microsoft / Amazon / Medical Supply / Home IoT App



How does it work?  
**Anna stays at home to get well.**

At the right time, the POTF app reminds Anna to take prescribed drugs, mark this action in the app, and check things like her temperature.



Based on the following technologies:  
 Progressive Web Apps / IoT / Health Notifications / WhatsApp

How does it work?  
**Anna wants more details about the new medicines.**

She scans the medicine packaging with the POTF app and instantly gets comprehensive information about the drug, possible replacements, and potential reactions with other drugs that she takes.

Based on the following technologies:  
 Microsoft / Amazon / Microsoft / Drug Machine Interface / QR / Barcode



How does it work?  
**Some side effects appear.**

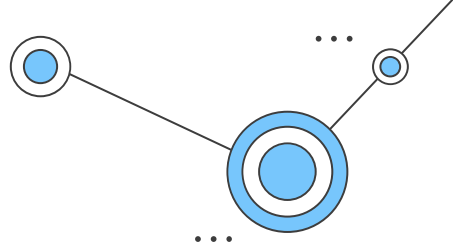
Anna feels some abdominal pain and wonders if it is a side effect of the new treatment. She uses the POTF app to consult with her pharmacist in her preferred way, by video call.

Based on the following technologies:  
 Cloud / Streaming / IoT / IoT gateway



# Concept of the Future of Pharmacy

(Divante Innovation Lab, 2020)



How does it work?

## Daily control of diabetes.

The app also reminds Anna about checking her blood-sugar every morning and evening. She uses a smart device integrated with the POTF app. All results are saved in the app and available to her doctor.



Based on the following technologies:  
 Fluid Notifications / SensorConnect / Digital / Personalized Content / Data Drive US

How does it work?

## End of insulin stock.

Anna's insulin ends but she is still sick and cannot leave home. She reorders insulin by asking her voice assistant to repeat the last order. The order and delivery details are visible in the app.



Based on the following technologies:  
 AI / Fluid Notifications / AlexaIO

How does it work?

## Same day delivery.

Anna marked that she needs the insulin supply the same day, and so the app communicates with a local courier company and makes sure she gets the new insulin stock in just a few hours.



Based on the following technologies:  
 REST API, integration with local delivery companies

How does it work?

## Periodic results control.

Along with the new insulin stock, the app suggests Anna goes for blood tests. It communicates with the medical center system and suggests available dates.



Based on the following technologies:  
 Fluid Notifications / Recommendation Engine / Personalized Content / Data Drive US

Pharmacy of the Future is how we imagine a perfect pharmaceutical system. Divided into multiple products and services, it becomes a complementary and flexible set of tools for various players at the intersection of the pharmaceutical, medical, and other related sectors.

All of these elements are centered around the patient.



# 02

## Pharmacoinformatics?

Definition



# What is Pharmacoinformatics?

Pharmaco = pharmakon (Bahasa Yunani) artinya Drug, Medicine

Farmasi = cara dan teknologi pembuatan obat serta cara penyimpanan, penyediaan, dan penyalurannya (KBBI)

Informatics = the science of processing data for storage and retrieval; information science.

Informatika = 1. ilmu tentang pengumpulan, klasifikasi, pe-nyimpanan, pengeluaran, dan penyebaran pengetahuan yang direkam; 2 hal-hal yang berkaitan dengan informasi; usaha dalam bidang informasi (KBBI)

Discipline where technology intersects with any aspects of drug delivery, from the **basic sciences** to the **clinical use** of medications in individuals and populations. Pharmacy Informatics, a subject of pharmacoinformatics, typically refers to the interface of technology with the practice of pharmacy (Gabriella Young, 2016)

...



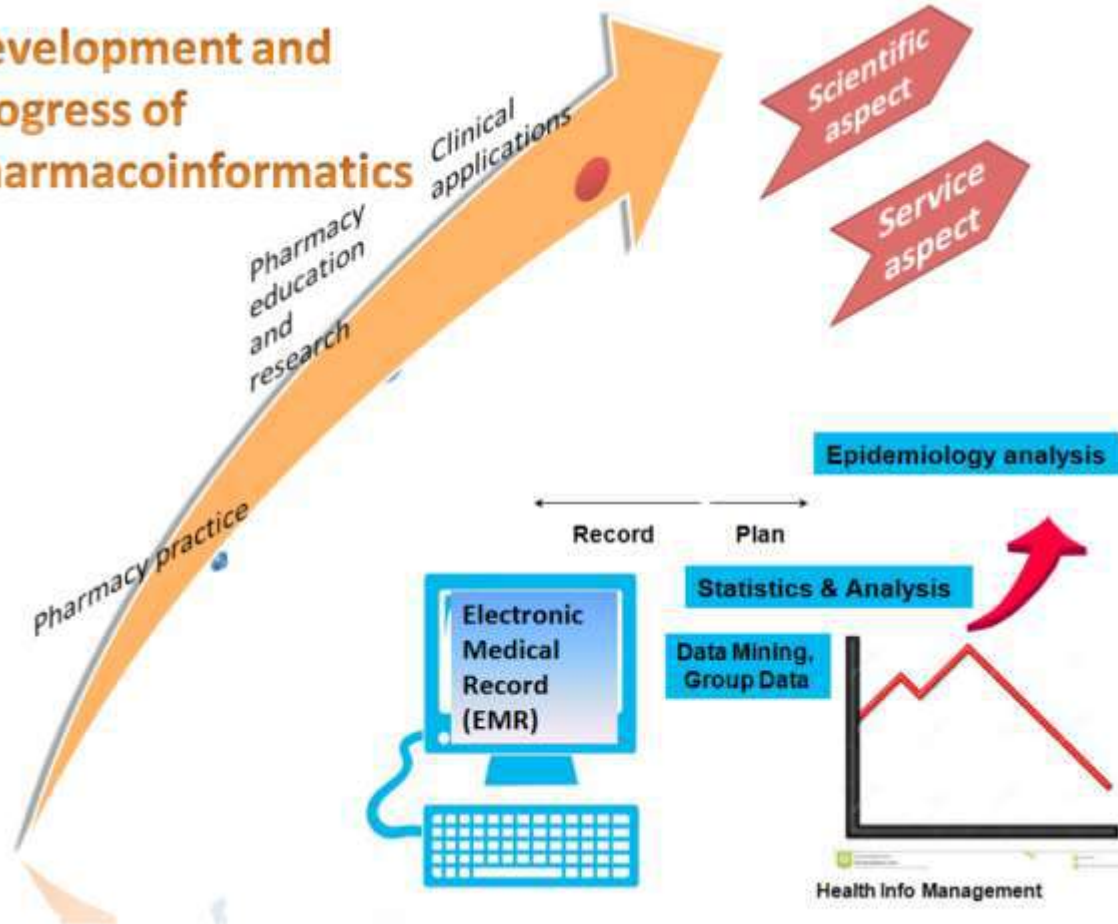
# 03

## Recent progress

History and perspective



# Development and Progress of Pharmacoinformatics

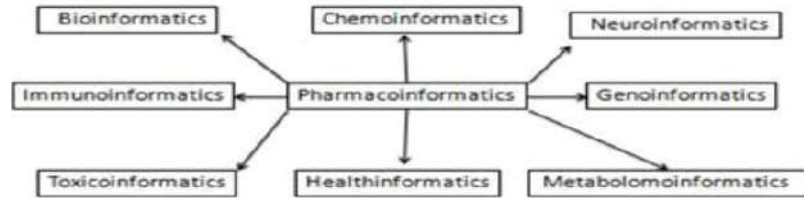


The work in pharmacoinformatics can be broadly divide into two categories-  
a) Scientific aspects b) Service aspects.

the drug discovery and development activities

the service-oriented aspects are more patient centric.

Figure 1: Classification of Pharmacoinformatics.



(Maithri Gundaram, 2016)



Secara singkat studi farmakoinformatika diklasifikasikan menjadi 5 bidang utama:

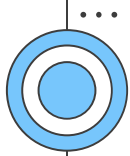
1. Layanan Informasi Obat,
2. Teknologi Informasi & Internet,
3. Manajemen Formularium Obat,
4. Manajemen rantai persediaan,
5. Kebijakan Kesehatan

(Imas Nur Amelia Zainal, 2017)



...

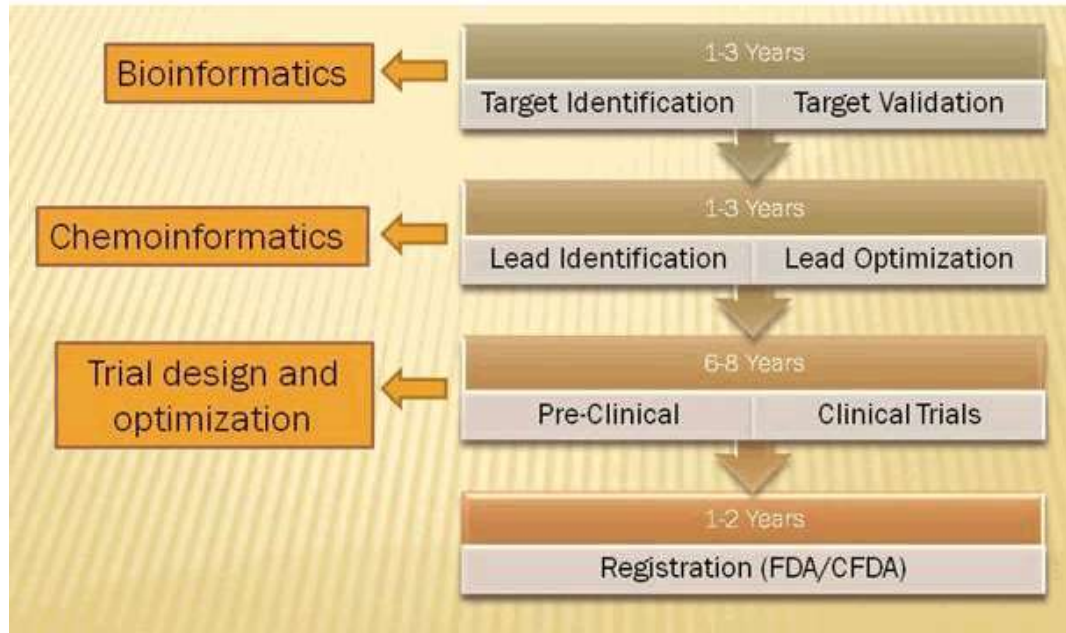


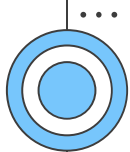


# Bioinformatics – Bioinformatika

Bioinformatika adalah bidang yang sedang trending dimana menggabungkan studi biologi dengan teknik informatika untuk mengembangkan kandidat obat farmasi yang efektif

Figure 2: Bioinformatics in drug discovery process.

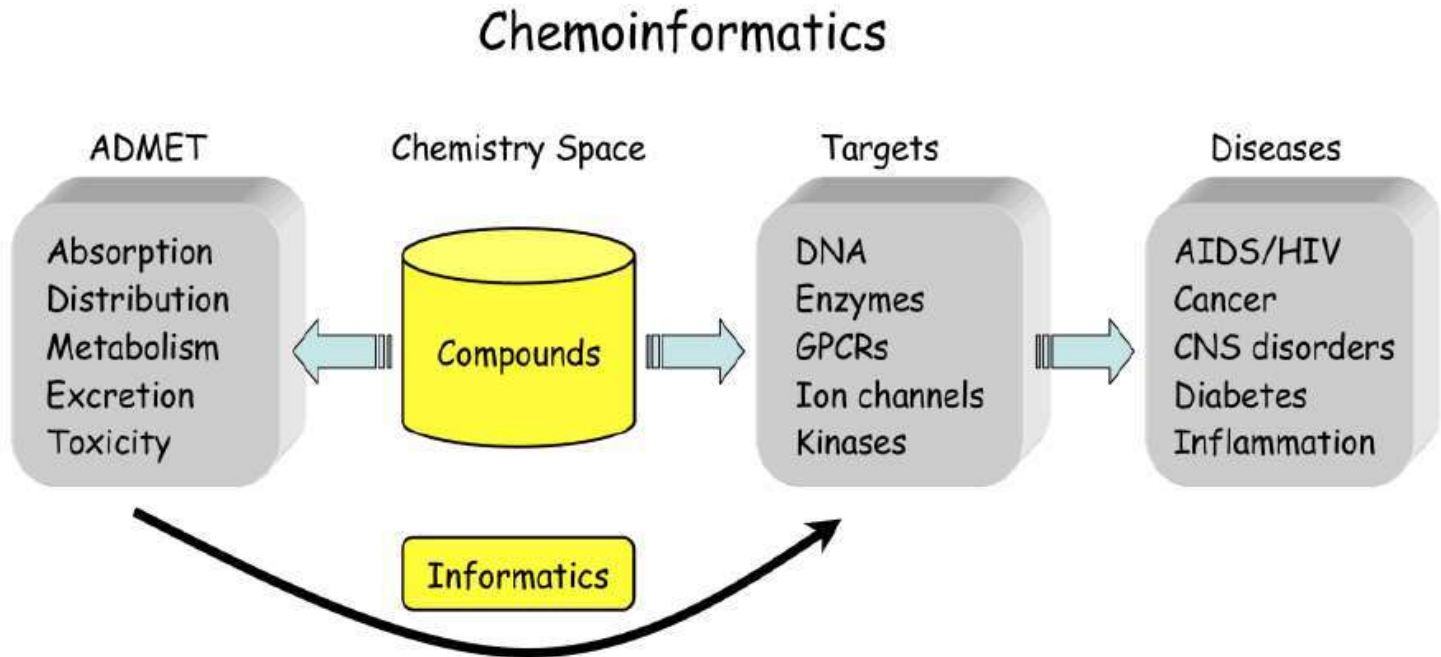


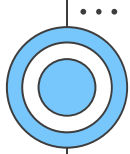


# Chemo informatics – Kemo informatika

Kemo informatika adalah teknik informatika untuk memecahkan masalah kimia dengan bantuan alat informatika.

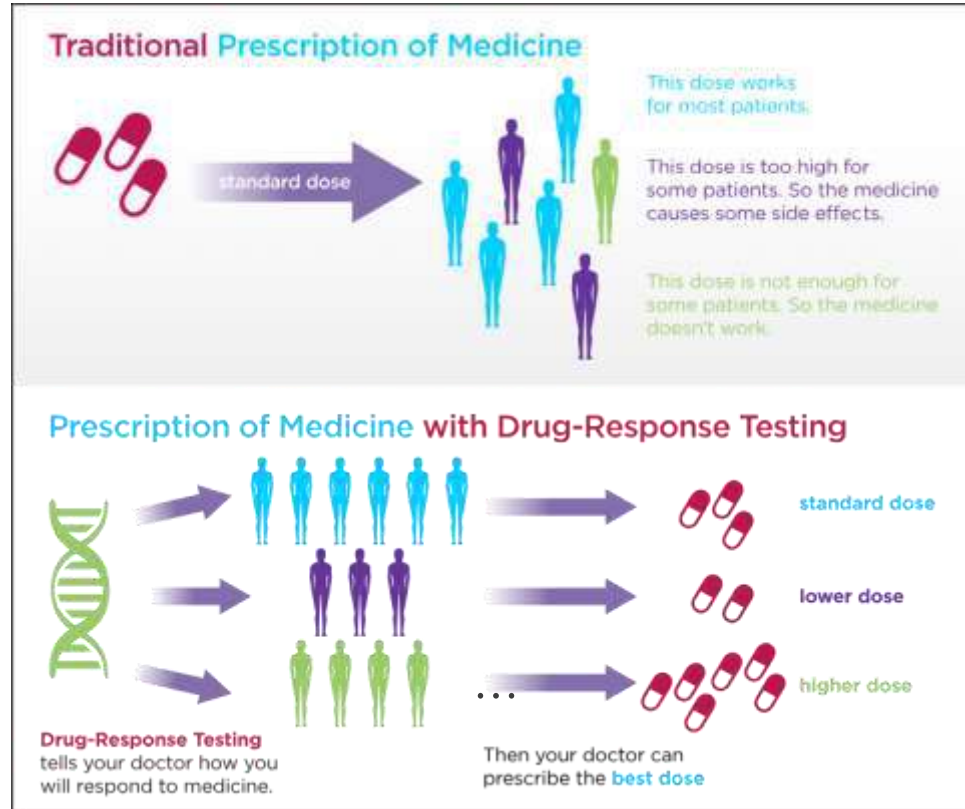
Figure 3: Flow char of Cheminformatics in drug discovery.





# Genoinformatic – Pharmacogenomic

“Studi tentang peran genom dalam respon obat”



# Pharmacoinformatics Education in India



Pharmacoinformatics in India can be available in National Institute of Pharmaceutical Education and Research

National Center for Pharmacoinformatics was established in the year 2002 at NIPER & upgraded to Department of Pharmacoinformatics in 2010;

The objectives are,

- To teach the science and art of "New Millennium Drug Discovery' for faster drug development.
- To teach the information management and integration techniques in the field of Biology, Chemistry, Toxicology, Pharmaceutical sciences and Pharmacy practice.
- To integrate diverse information into discovery knowledge by exploiting the advantages of emerging fields like bio-informatics, chemo-informatics, toxico-informatics, pharmacy-informatics, etc

...

# Pharmacoinformatics Education in India



## *Drug Design and Development Software Tools*

Pharmacoinformatics NIPER, S.A.S. Nagar

**BiAnaCA**

For the data analysis of end-point biochemical assay (Updated Version 0.1).

**IPAT**

Intelligent Patent Analysis Tool (IPAT).

**CPMD IFGen Server**

For generating input file for CPMD (Car Parrinello Molecular Dynamics).

**ReSite**

For analyzing the active site residues of docked poses in Molecular Docking.

**DoPoSe-CYP**

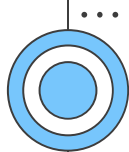
For analyzing docking poses on the basis of distance between site of metabolism of ligand and  $Fe^{+2}$  center in CYP enzymes.

**ChemCLEAN**

For optimizing the geometry of 2D-structures which are drawn on panel or uploaded as \*.mol / \*.mol2 file.

**DruLITo**

For screening lead molecules based on different drugs likeness rules.



## Simak, Ini Prodi Saintek dan Soshum Terfavorit Pelamar SNMPTN 2021

LTMPT telah mengumumkan 20 prodi dengan persaingan ketat, baik untuk kelompok Saintek atau Soshum.

Hal tersebut disampaikan Ketua LTMPT Mohammad Nasir dalam konferensi pers pengumuman hasil SNMPTN 2021 yang terselenggara pagi tadi.

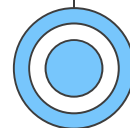
Berikut daftar prodi dengan persaingan ketat untuk kelompok Saintek.

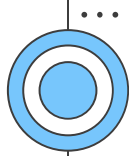
1. Teknik Informatika Universitas Padjajaran, dengan keketatan 1:100
2. Farmasi Universitas Sebelas Maret, dengan keketatan 1:91
3. Keperawatan Universitas Sultan Ageng Tirtayasa, dengan keketatan 1:80
4. Farmasi Universitas Syiah Kuala, dengan keketatan 1:79
5. Farmasi Universitas Padjajaran, dengan keketatan 1:77
6. Farmasi Universitas Diponegoro, dengan keketatan 1:75
7. Gizi Universitas Pendidikan Indonesia, dengan keketatan 1:70
8. Informatika Universitas Sultan Ageng Tirtayasa, dengan keketatan 1:68
9. Farmasi Universitas Negeri Semarang, dengan keketatan 1:68
10. Psikologi Universitas Padjajaran, dengan keketatan 1:67

## 20 Prodi Terfavorit SNMPTN 2020

Melansir *Kompas.com*, 3 Februari 2021, menurut data LTMPT berikut ini adalah 10 prodi saintek dengan keketatan tertinggi pada SNMPTN 2020:

1. Teknik Informatika, Universitas Padjajaran (1,20 persen).
2. Farmasi, Universitas Diponegoro (1,26 persen).
3. Farmasi, Universitas Sebelas Maret (1,38 persen).
4. Farmasi, Universitas Syiah Kuala (1,61 persen).
5. Kedokteran Gigi, Universitas Diponegoro (1,73 persen).
6. Teknik Informatika, Universitas Hasanuddin (1,80 persen).
7. Teknik Informatika, Universitas Islam Negeri Sunan Kalijaga (1,85 persen).
8. Farmasi, Universitas Padjajaran (1,88 persen).
9. Teknik Informatika, Universitas Negeri Malang (1,88 persen).
10. Farmasi, Universitas Jenderal Soedirman (1,89 persen).

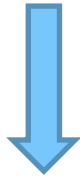




# Perkumpulan Informatika Farmasi Indonesia (PIFI)



1 Mei 2017



Perkumpulan  
Informatika Farmasi  
Indonesia

Maret 2022

PIFI mengajak para pendiri dan mitra ekosistem kesehatan:

1. Akademik : Fakultas Farmasi / Sains / Biomedis
2. Bisnis: pendiri startup: Farmasi, alat kesehatan, genomik, nutrisi/makanan, biofarmasi
3. Korporasi Pemerintah & LSM: Kementerian/Lembaga dan Dinas Kesehatan, perusahaan kesehatan dan LSM di bidang kesehatan.
4. Komunitas: komunitas kesehatan, komunitas pengembangan TI, asosiasi fasilitas kesehatan, fasilitas kesehatan, LSM dan komunitas kesehatan/farmasi lainnya.



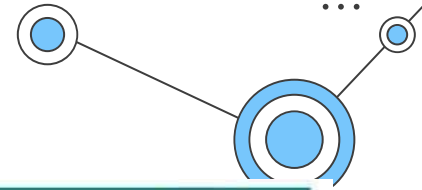
Transformasi teknologi kesehatan dan transformasi ketahanan sistem kesehatan (sektor farmasi & alkes).



Membangun ekosistem kesehatan digital di Indonesia, khususnya di bidang farmasi, alat kesehatan, jamu, biofarmasi, dan genomik.



# CETAK BIRU (BLUEPRINT) STRATEGI TRANSFORMASI DIGITAL KESEHATAN



## Tantangan : Jutaan Data & Ratusan Aplikasi

Kebijakan belum berbasis pada data dan pelayanan yang kurang efisien



Kepmenkes nomor HK.01.07/MENKES/1559/2022 tentang PENERAPAN SISTEM PEMERINTAHAN BERBASIS ELEKTRONIK BIDANG KESEHATAN DAN STRATEGI TRANSFORMASI DIGITAL KESEHATAN. 7 Oktober 2022.

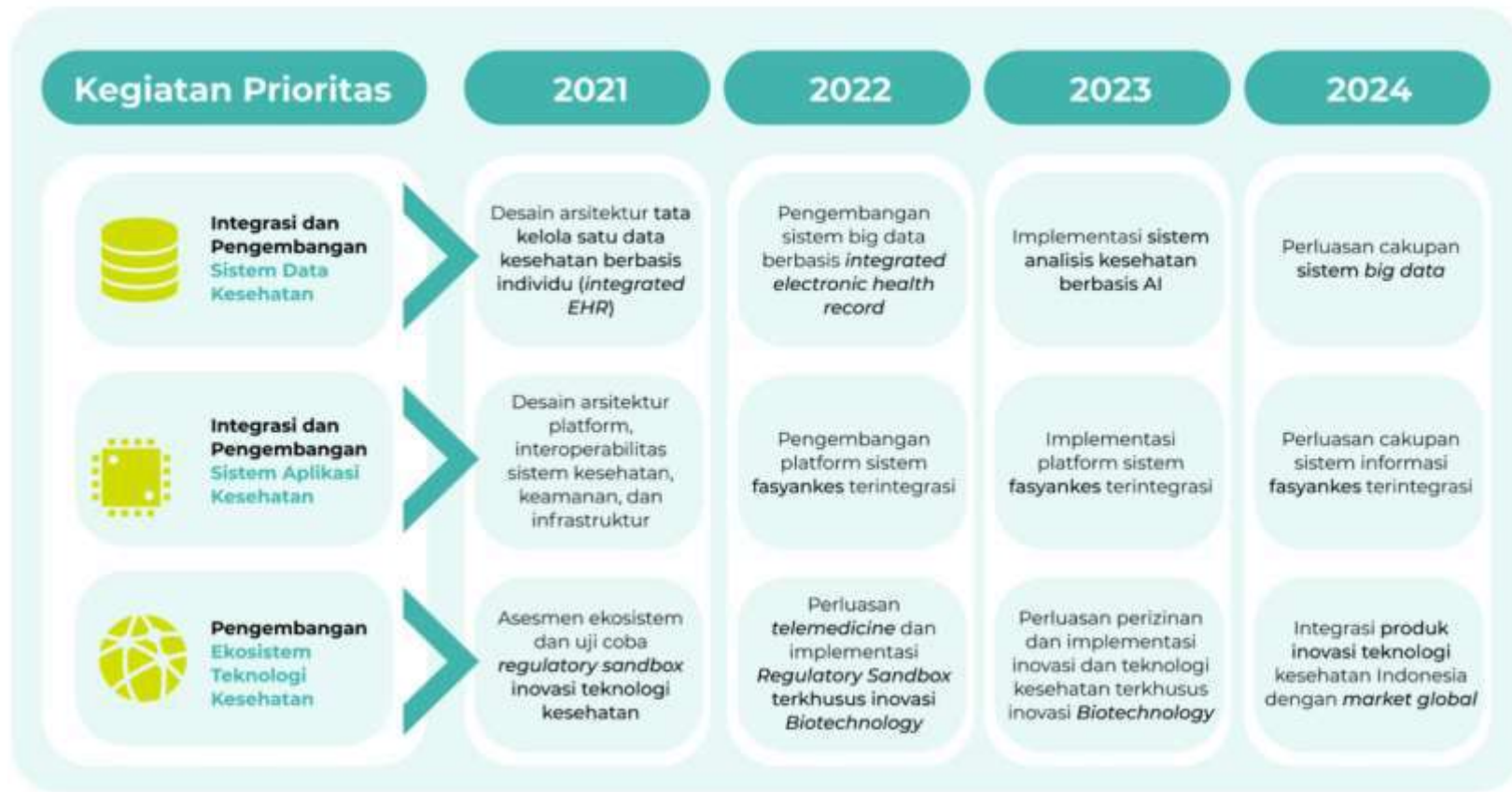


# Transformasi Teknologi Kesehatan (Kegiatan Prioritas)



Kepmenkes nomor HK.01.07/MENKES/1559/2022 tentang PENERAPAN SISTEM PEMERINTAHAN BERBASIS ELEKTRONIK BIDANG KESEHATAN DAN STRATEGI TRANSFORMASI DIGITAL KESEHATAN.

# Peta Jalan Transformasi Teknologi Kesehatan



Kepmenkes nomor HK.01.07/MENKES/1559/2022 tentang PENERAPAN SISTEM PEMERINTAHAN BERBASIS ELEKTRONIK BIDANG KESEHATAN DAN STRATEGI TRANSFORMASI DIGITAL KESEHATAN.

# 7 Prinsip Utama Pembangunan Platform SATUSEHAT



## Platform Berbasis Layanan



Data kesehatan nasional bersumber dari penyelenggaraan pelayanan kesehatan, dimana data dihasilkan seiring penyelenggaraan pelayanan kesehatan, tidak terbagian menjadi beberapa berkas yang bersifat agregat yang cenderung memberikan tambahan beban administrasi serta tidak memberikan tingkat kedalaman data yang memadai untuk analisa lanjutan.

## Standardisasi Arsitektur dan Spesifikasi

Platform SATUSEHAT merupakan aspek atau standarisasi arsitektur dan spesifikasi pertukaran data antar pelaku industri kesehatan, tidak untuk menstandarkan menjadi suatu aplikasi tunggal.



## Kolaborasi Ekosistem Pelaku Industri kesehatan



Platform SATUSEHAT bukan untuk mengorganisir sistem atau aplikasi apa yang telah ada saat ini, namun platform ini akan dijadikan wadah yang digunakan oleh seluruh pelaku industri kesehatan.

## Open API Berbasis *Microservices*

Platform SATUSEHAT menyediakan layanan pertukaran data yang dapat digunakan secara terbuka oleh seluruh pelaku industri kesehatan.



## Kepatuhan melalui keterpaduan



Platform SATUSEHAT menjadi sarana bagi Kemenkes untuk memantau kepatuhan atas persyaratan data maupun pemenuhan standar pelayanan minimal seluruh pelaku industri kesehatan melalui aktivitas transaksi yang terintegrasi.

## Manfaat Imbal Balik melalui Kemudahan Layanan dan Informasi Terintegrasi

Platform SATUSEHAT memberikan imbal hasil manfaat bagi seluruh ekosistem pelaku industri kesehatan yang tergasung didalamnya, berupa dua hasil olahan big data/analytica serta informasi terintegrasi.



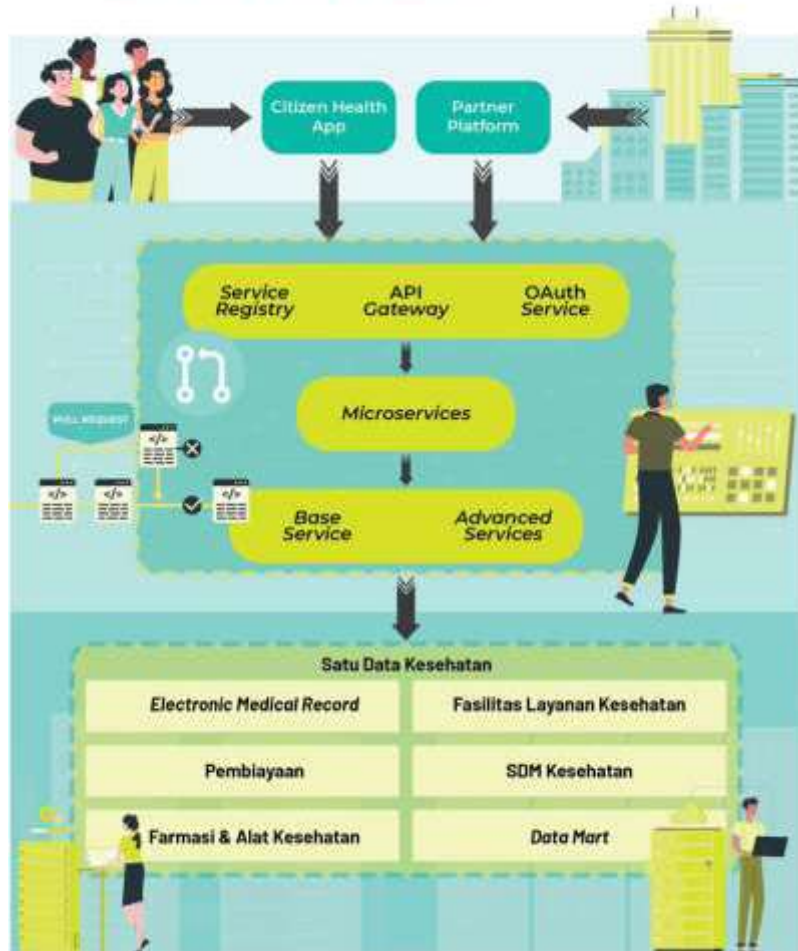
## Platform yang Berorientasi Pada Pengguna



Pengembangan platform harus fokus dan memperhatikan kebutuhan pengguna, mulai dari tampilan antarmuka pengguna hingga tampilan pengalaman pengguna pada sebuah platform. Sehingga, feedback dari pengguna menjadi dasar dalam pengembangan maupun perbaikan fitur-fiturnya.

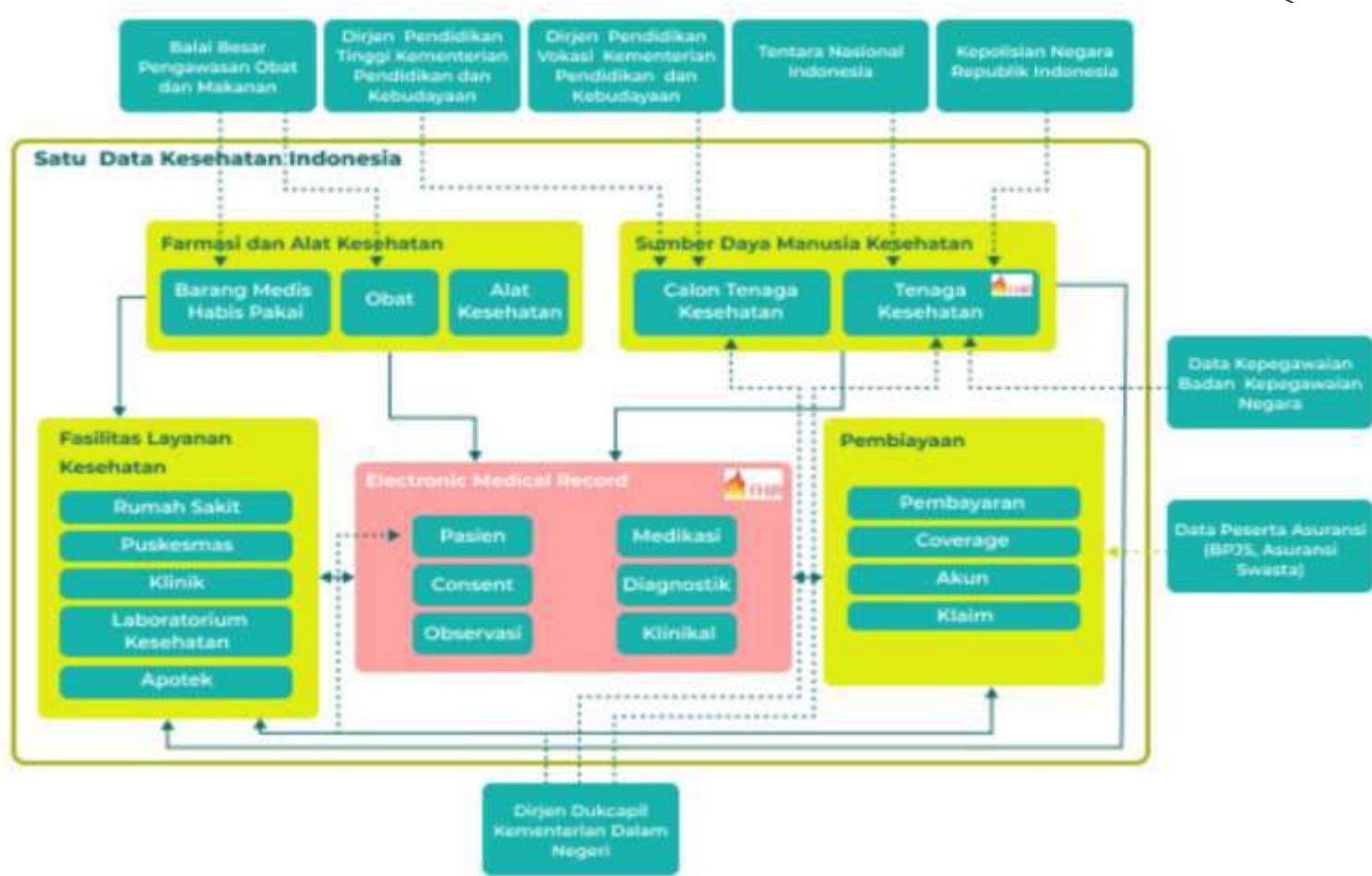
Fokus transformasi pada pengembangan data kesehatan, pengembangan aplikasi layanan kesehatan dan peningkatan ekosistem teknologi kesehatan diharapkan dapat menciptakan peningkatan mutu data beserta lebarnya hingga menghasilkan efisiensi pelayanan kesehatan. Cetak Biru Strategi Transformasi Digital Kesehatan 2024 hadir sebagai solusi bagi Indonesia dalam menatap masa depan ke arah transformasi digital yang terukur dan terarah untuk pembangunan sistem pelayanan kesehatan yang terintegrasi dan berkelanjutan.

# Struktur Inti Platform SATUSEHAT

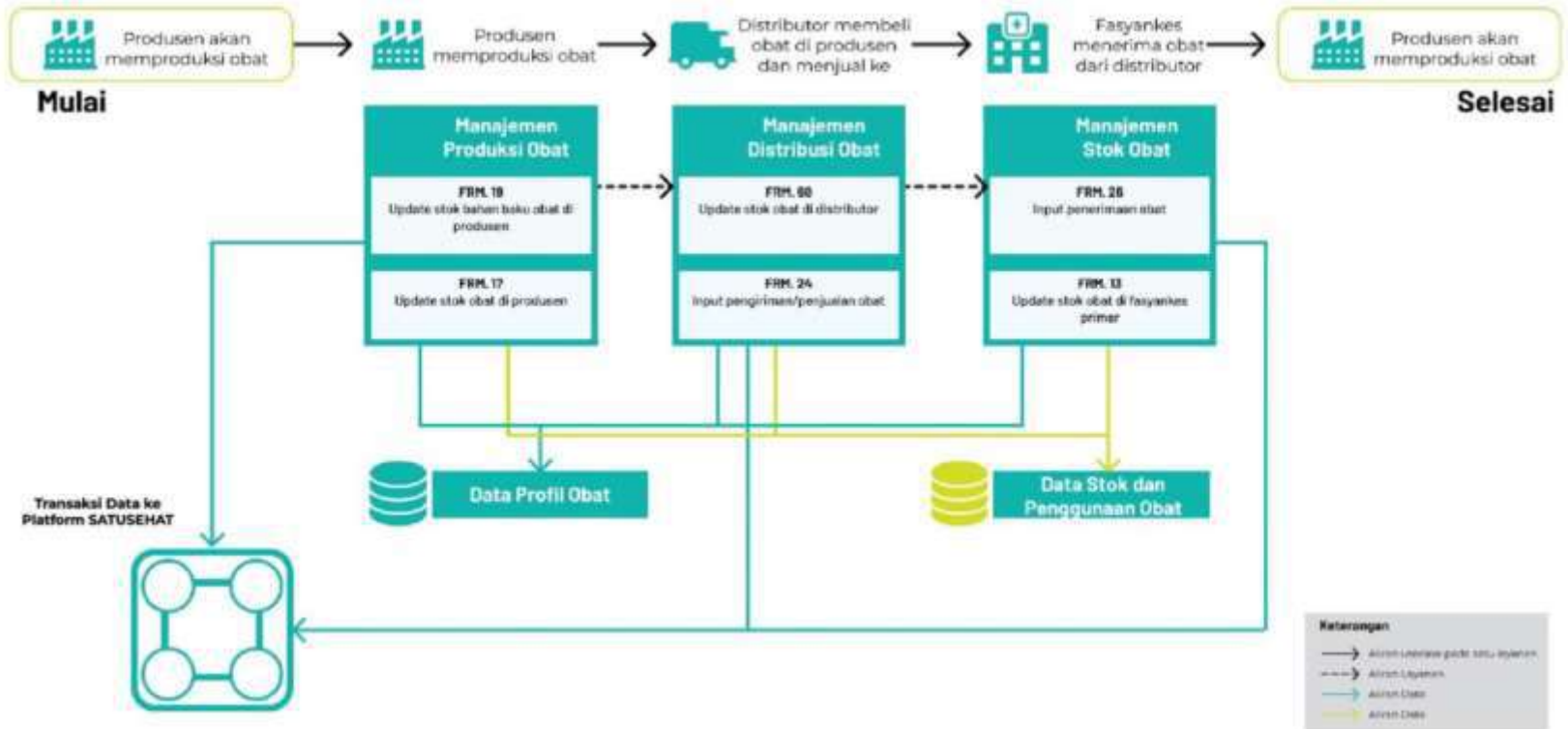




# Arsitektur Data



# Alur Layanan & Data Rantai Suplai Obat dari Produsen ke Fasyankes Primer

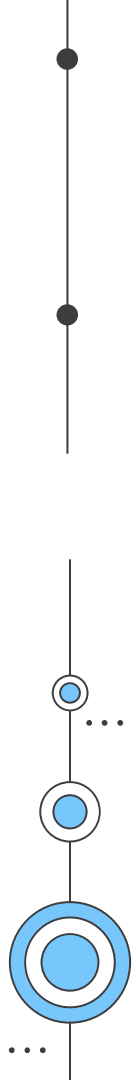


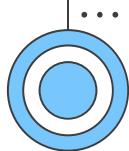


# 04

## Best Practices

What we can do?





# Pharmacoinformatics in Scientific Aspects

J Young Pharm, 2019;11(1):31-35

A multifaceted peer-reviewed journal in the field of Pharmacy  
www.jyoungpharm.org | www.zhoog.net

Original Article

## Host-Guest Interactions of $\alpha$ -Mangostin with ( $\alpha$ , $\beta$ , $\gamma$ )-Cyclodextrins: Semi-Empirical Quantum Mechanical Methods of PM6 and PM7

Doni Dermawan<sup>1</sup>, Nasrul Wathoni<sup>2</sup>, Muchtaridi Muchtaridi<sup>3\*</sup>

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<sup>2</sup>Department of Pharmaceutics and Pharmaceutical Technology, Faculty of Pharmacy, Universitas Padjadjaran, Sumedang, West Java- 45363, INDONESIA.

<sup>3</sup>Department of Pharmaceutical Analysis and Medicinal Chemistry, Faculty of Pharmacy, Universitas Padjadjaran, Sumedang, West Java- 45363, INDONESIA.

### ABSTRACT

**Objective:** This study aimed to investigate the molecular interactions, geometrical properties, encapsulation process and calculated energy of the inclusion complex system between  $\alpha$ -mangostin (guest) with  $\alpha$ -cyclodextrin,  $\beta$ -cyclodextrin and  $\gamma$ -cyclodextrin (hosts) in an aqueous environment using the semi-empirical quantum mechanical methods of PM6 and PM7. **Materials and Methods:** Molecular docking simulation and semi-empirical quantum mechanical calculations of PM6 and PM7 were employed to identify the molecular interactions between  $\alpha$ -mangostin and three types of cyclodextrin. **Results:** The inclusion complex formation energy values of all  $\alpha$ -mangostin/cyclodextrin that obtained by the semi-empirical PM7 method were significantly lower than complexation energy obtained by the semi-empirical PM6 method. **Conclusion:** The inclusion complex of  $\alpha$ -mangostin/ $\gamma$ -cyclodextrin is the most favorable pathway of inclusion complex formation of  $\alpha$ -mangostin with cyclodextrin because it

has the highest negative value of free binding energy ( $\Delta G$ ) and complexation energy ( $\Delta E$ ) compared to  $\alpha$ -mangostin/ $\alpha$ -cyclodextrin and  $\alpha$ -mangostin/ $\beta$ -cyclodextrin.

**Key words:** Alpha mangostin, Cyclodextrin, Host-guest interactions, PM6, PM7.

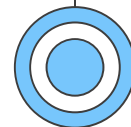
### Correspondence

**Muchtaridi Muchtaridi**, Department of Pharmaceutical Analysis and Medicinal Chemistry, Faculty of Pharmacy, Universitas Padjadjaran, Sumedang, West Java- 45363, INDONESIA.

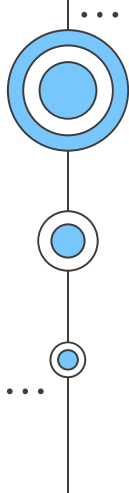
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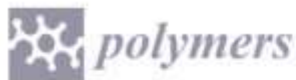
DOI: 10.5530/jyp.2019.11.7







# Pharmacoinformatics in Scientific Aspects



Article

## In silico study: combination of $\alpha$ -mangostin and chitosan conjugated with trastuzumab against human epidermal growth factor receptor 2

Sandra Megantara <sup>1\*</sup>, Nasrul Wathoni <sup>2</sup>, Cecep Suhandi <sup>1</sup>, Maryam H. Ishmatullah <sup>1</sup> and Melisa F. F. D. Putri <sup>1</sup>

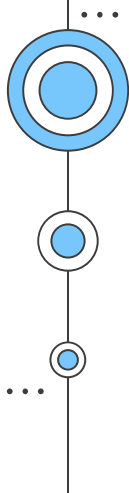
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<sup>2</sup> Department of Pharmaceutics and Pharmaceutical Technology, Universitas Padjadjaran, Sumedang-45363, (West Java) Indonesia

\* Correspondence: s.megantara@unpad.ac.id

**Abstract:** Breast cancer is a type of cancer with the highest prevalence worldwide. Almost 10-30% breast cancer cases show a positive diagnosis of HER2 (Human Epidermal Growth Factor Receptor 2). The currently available treatment methods still exhibit many shortcomings such as high incidence of side effects and treatment failure due to resistance. This in silico study aims to simulate  $\alpha$ -mangostin and chitosan combination conjugated to trastuzumab formulation against HER2 as an effort to improve breast cancer patient therapy. This molecular docking simulation was done through using PatchDock Server. The materials used including the two-dimensional structure of  $\alpha$ -mangostin, chitosan, and sodium tripolyphosphate from the PubChem database, trastuzumab FASTA sequence from the DrugBank database, and HER2 structure obtained from a crystal complex with PDB ID: 1N8Z. The results showed that the particle of  $\alpha$ -mangostin and chitosan combinations interacted mostly with the crystallizable fragment (Fc region) of trastuzumab in the conjugation





# Pharmacoinformatics in Service Aspects

Journal of Multidisciplinary Healthcare

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REVIEW

## Telepharmacy: A Potential Alternative Approach for Diabetic Patients During the COVID-19 Pandemic

Ghina Nadhifah Iftinan<sup>1</sup>  
Nasrul Wathoni<sup>2,3</sup>  
Keri Lestari<sup>3,4</sup>

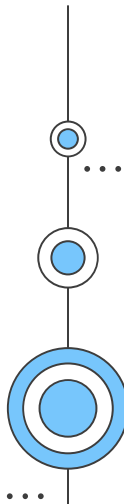
<sup>1</sup>Bachelor Program in Pharmacy, Faculty of Pharmacy, Universitas Padjadjaran, Sumedang, 45363, Indonesia;

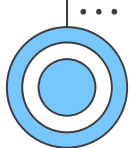
<sup>2</sup>Department of Pharmaceutics and Pharmaceutical Technology, Faculty of Pharmacy, Universitas Padjadjaran, Sumedang, 45363, Indonesia; <sup>3</sup>Indonesia Test Trace and Isolation (InaTTI), Medication Therapy Adherence Clinic (MTAC), Universitas Padjadjaran, Sumedang, 45363, Indonesia;

<sup>4</sup>Department of Pharmacology and Clinical Pharmacy, Faculty of Pharmacy, Universitas Padjadjaran, Sumedang, 45363, Indonesia

**Abstract:** The use of telepharmacy technology allows pharmacists to provide clinical pharmaceutical services to patients with diabetes mellitus (DM) who need regular services during the COVID-19 pandemic while maintaining distance and minimizing face-to-face meetings. The purpose of this review article was to identify the impact of telepharmacy intervention by pharmacists in diabetic patients by reviewing clinical outcomes and patient therapy adherences. A literature search was conducted through the PubMed database using the terms "telemedicine", "telepharmacy", "telehealth" and "telephone" in combination with "pharmacist", "diabetes" and "COVID-19" or "Pandemic". From a total of 67 articles identified, 14 research articles conform to the inclusion criteria. Telephone is the most widely used communication model (n = 11). All studies had a positive impact on clinical outcomes and three studies did not provide significant result on therapy adherence. The use of telepharmacy can be maximized and used on a vast scale, with the design of devices and technologies making it easier for pharmacists and diabetic patients to provide and receive clinical pharmaceutical services during the COVID-19 pandemic.

**Keywords:** pharmacist, clinical pharmaceutical services, diabetes mellitus, telepharmacy, COVID-19





# Pharmacoinformatics in Service Aspects

Journal of Multidisciplinary Healthcare

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REVIEW

## Application, Benefits, and Limitations of Telepharmacy for Patients with Diabetes in the Outpatient Setting

Ghina Nadhifah Ibtinan<sup>1</sup>, Khaleed M Elamin<sup>2</sup>, Susi Afranti Rahayu<sup>3</sup>, Keri Lestari<sup>4,5</sup>, Nasrul Wathoni<sup>6,8</sup>

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Correspondence: Nasrul Wathoni; Keri Lestari, Department of Pharmacoetics and Pharmaceutical Technology Faculty of Pharmacy Universitas Padjadjaran, Jl. Raya Bandung Sumedang KM 21, Jatinangor, 451363, Indonesia, Tel: +622 842 888888 3510, Fax: +622 842 888888, Email: nasrul@unpad.ac.id, lestari.k@unpad.ac.id

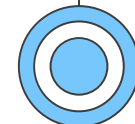
**Abstract:** After the COVID-19 pandemic, telepharmacy has become increasingly widely used as an alternative to pharmaceutical care by remote pharmacists. Patients with diabetes mellitus are one of the patients who get benefits the most from telepharmacy practices, which allow patients to consult without meeting face to face and minimize the risk of virus transmission. The authors conduct an assessment of the benefits and limitations of using telepharmacy that are used throughout the world and then hopes that they can become a reference in the development of telepharmacy in the future. A total of 23 relevant articles were used for analysis in this narrative review after searching for articles in three sources, including PubMed, Google Scholar and ClinicalTrials.gov, until October 2022. This narrative review shows that telepharmacy plays an important role in improving clinical outcomes, patient therapy adherence and reduce the number of patient visit and hospitalization, but telepharmacy also has limitations in its use related to security and privacy, as well as pharmacist intervention that has not been maximized. However, telepharmacy has great potential to facilitate diabetes mellitus patients in pharmaceutical services.

**Keywords:** diabetes mellitus, telepharmacy, benefits, limitations, pharmacist, COVID-19

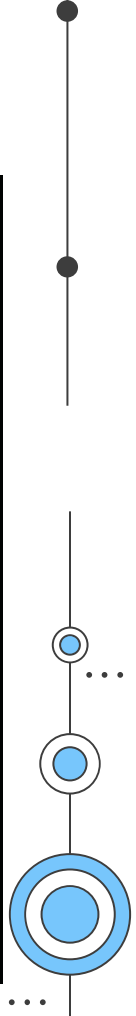
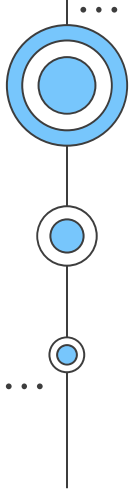
### Introduction

The application of information and communication technology in the health sector is currently being widely used, especially since the COVID-19 pandemic.<sup>1</sup> The provision of health services through information technology is proven to help ease the burden on the health sector. One of them is telepharmacy. Telepharmacy has been highlighted as an

Journal of Multidisciplinary Healthcare: An International Open Access Peer-Reviewed Journal, Volume 14, Issue 1, June 2022. For information on this journal, please visit [www.dovepress.com](http://www.dovepress.com).









# No 1 di google, terindeks google news

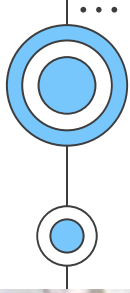
Google search results for "farmasi". The top result is from "Masa Farmasi" with the headline "5 Tren Digital Farmasi di Masa Depan". The snippet reads: "Setelah bertahun-tahun memusatkan teknologi digital dalam multitalentum, masa depan farmasi akan didominasi oleh inovasi berbasis AI, big data, dan cloud computing." The article is dated "17 hours ago".

Google search results for "apoteker". The top result is from "Masa Farmasi" with the headline "PP (AI) : Apoteker Berperan Penting Sukseskan Vaksinasi COVID-19". The snippet reads: "Yakin apoteker yang bekerja di berbagai Farmasi selama bertahun-tahun memiliki keterampilan dalam menyebarkan vaksin, baik itu injeksi atau...". The article is dated "4 days ago".

Google search results for "ruu kelampayan". The top result is from "Masa Farmasi" with the headline "RUU Kelampayan Tak Masuk Prolegnas 2021, ISMAFARSI Kirim Surat Terbuka Untuk Jokowi". The snippet reads: "Masa Farmasi - Tim Haturnya RUU Kelampayan dalam agenda Program Legislasi Nasional (Prolegnas) prioritas masih dibahas dan...". The article is dated "1 week ago".

Google search results for "tanya apoteker". The top result is from "farmasiika.com" with the headline "Tanya Apoteker - Info Farmasi Terkini Berbasis Ilmiah dan...". The snippet reads: "Berawal dilahiri di Tanya Apoteker, tempat berkonsultasi gratis terkait Apoteker yang akan bergabung dengan obat para-Apoteker yang telah kami...". The article is dated "1 week ago".

# StartUp Platform Berbagi Info Kefarmasian



APT. ARDIYANSYAH KAHURIPAN, M.Si



KTA.27121981000309

## Surat Cinta untuk Para Ayahanda Khususnya Ayahanda Apoteker Chazali

5 April 2022 Berita, Opini



IKATAN  
APOTEKER  
INDONESIA

didalam Permenkes, eksistensi ...

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Majalah Farmasetika – Rubrik Opini. Beba surat terbuka yang ditulis ayahanda Apoteker Chazali H Situmorang masuk ke WhatsAp ada yang meminta tanggapan atau hanya menginfokan. Awalnya tidak tertarik untu menanggapi karena permasalahan kefan sudah sangat kompleks dan berlanut-lanru kedudukan profesi yang tampak dikedirik

DECKY FERDIANSYAH



Decky Ferdiansyah, S.Si, Apt. Seorang praktisi dan pemerhati kesehatan yang bekerja sebagai PNS di Badan Perencanaan Pembangunan Daerah (Bappeda) Provinsi Lampung. Lulus sebagai Apoteker pada Tahun 2004 dari Universitas Padjadjaran Bandung. Tercatat sebagai anggota Ikatan Apoteker Indonesia (IAI) Provinsi Lampung. Menyukai aktivitas membaca dan menulis. Saat ini sedang menempuh Program Pascasarjana Studi Pembangunan di Institut Teknologi Bandung

[@dekyferdiansyah](#)

## Apoteker dan Konsep Kolaborasi Interprofesionalitas Tenaga Kesehatan dalam Program JKN

3 Oktober 2018 Opini



kemajuan kehidupan berbangsa. Lalu bagaimana ...

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Farmasetika.com – Kesehatan merupakan hak asasi warga negara dan salah satu unsur kesejahteraan umum yang harus diwujudkan dalam kehidupan berbangsa. Perwujudan tersebut dilakukan untuk mencapai derajat kesehatan individu dan masyarakat yang setinggi-tingginya. Derajat kesehatan individu dan masyarakat yang tinggi merupakan salah satu modal penting bagi

apt. Frandy Putra Perdamen Tarigan -Apoteker Peduli SDGs- branding of Indonesian Young Pharmacist Group PFI-IAI- Panda Digital Kementerian Komunikasi dan Informatika

## Tak Nampak Namun Berdampak : "Discover The New Age of Pharmacy Experience"

1 hari ago Berita, YPG



Majalah Farmasetika – YPG Pengurus Pusat IAI kembali mengukir kemangan di Bandung dengan mengadakan kegiatan YPG Talk pada tanggal 12 Maret 2022 tepatnya di auditorium IFT (Institut Francis Indonesia). Kegiatan yang merupakan pilot project YPG Lawan Covid ini mengusung tema "Discover The New Age of Pharmacy Experience". Kegiatan ini terinspirasi ...

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<https://farmasetika.com/kirim-artikel>





# Pharmacoinformatics Education in Faculty of Pharmacy, UNPAD



**PELUNCURAN PROGRAM KAMPUS MERDEKA**  
Mata kuliah farmasi informatika dan manajemen, regulasi dan kewirausahaan

Pembicara Tamu  
apt. Mahirsyah Wellyan, M. Sc.  
Founder Startup Farmakoterapi.com  
"Peran Apoteker dalam Startup Digital Farmasi: Konsultasi Obat Online"

Jum'at, 13 Agustus 2021  
Meeting ID: 344 387 7199  
Passcode: ffunpad  
Link : <https://bit.ly/KickOffKampusMerdeka>

376 Mahasiswa Registered

Kegiatan Kampus Merdeka ini diikuti oleh :



# Pharmacoinformatics Education in Faculty of Pharmacy, UNPAD



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#### Farmasi Informatika



Kode Mata Kuliah : P10A.0726

Semester : Gasal 2021/ 2022

Bobot Mata Kuliah (SKS) : 2

Deskripsi Mata Kuliah :

MK **Farmasi Informatika** mempelajari bidang **farmasi** yang melibatkan penggunaan **informatika** dan teknologi internet untuk menargetkan masalah terkait obat. Ini difokuskan pada perolehan, penyebaran, penyimpanan, analisis, dan penggunaan pengetahuan dan data terkait obat dalam rangkaian sistem perawatan kesehatan.

Category: Fakultas Farmasi

Teacher: Irma Melyani Puspitasari 197905012006042002

Teacher: Dr. Ira Mirawati, M.Si 198205152008122003

Teacher: Raden Bayu Indradi 199303142018031002

Teacher: Sandra Megantara

Teacher: asaas putra

Teacher: Abd. Kakhar Umar

Teacher: Nasrul Wathoni

Teacher: Sriwidodo, Dr.Msi.,Apt. Widodo



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**InaTTi Apps**  
from Indonesia  
to the world



# Inovasi yang Diusulkan

## InaTTi versi 2 (Telefarmasi)

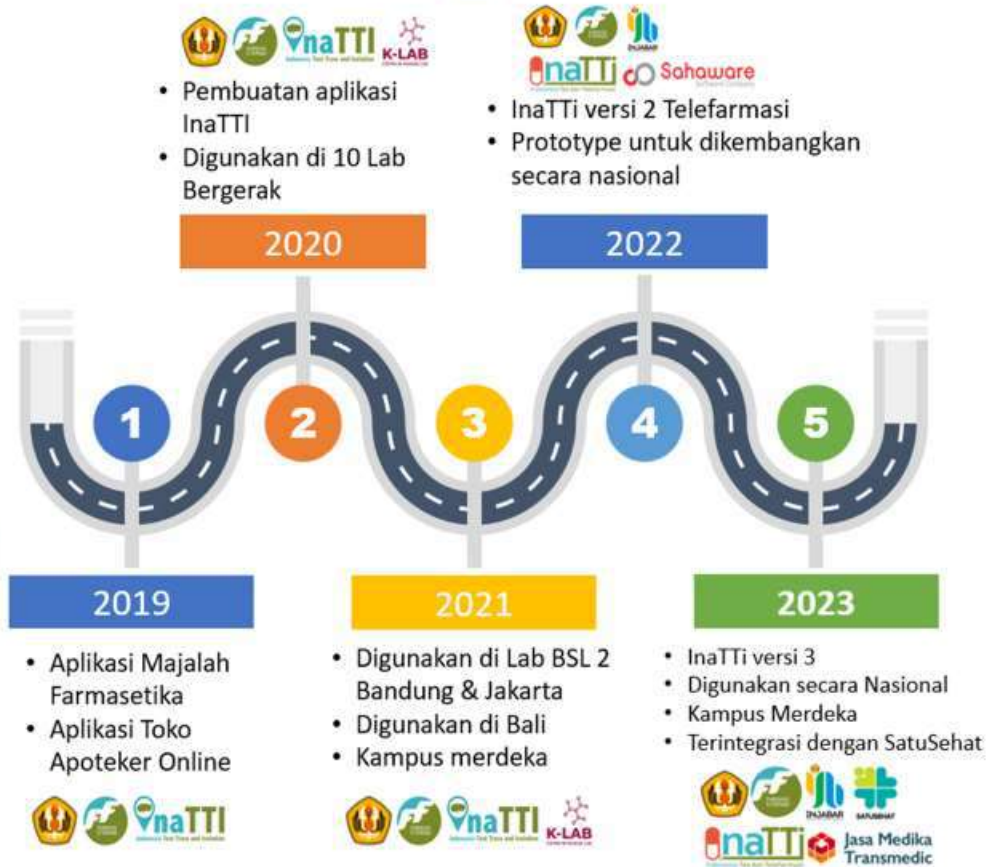
Diujicoba di 2 Laboratorium, 10 klinik di Bandung dan Bali, Apotek Kimia Farma se-Bandung, Jakarta, Semarang dan Surabaya (Tahun 2022)

### Farmalab

1. Klinik rancamanyar
2. Klinik rancaekek medika
3. Klinik sehat 24 jam
4. Klinik Unpad Dipatiukur
5. Klinik Unpad Jatinangor

### Lab Warmadewa

1. GSI Sintesa Jimbaran
2. Klinik Osadha
3. Ulab Kerobokan
4. Aero Globe Bali
5. KPH Undagi Farma



# Fitur InaTTi Apps Versi 2



Aplikasi berbasis website yang menyediakan akses mudah terhadap layanan Tes COVID-19 dan Telefarmasi bersama Apoteker tersertifikasi.

**naTTi Apoteker**  
*apoteker.inatti.id*

Mengelola instalasi farmasi dan pasien, terutama untuk pembuatan PMR dan Telefarmasi

**naTTi User**  
*app.inatti.id*

Memesan dan melakukan layanan Tes, Vaksinasi, serta Telefarmasi

**naTTi Faskes Group**  
*faskes-grup.inatti.id*

Mengelola Apotek dan Instalasi Farmasi yang berada di bawah satu Unit Bisnis yang sama

**naTTi Rujukan**  
*ref.inatti.id*

Mengelola aktivitas pada Fasilitas Kesehatan sebagai rujukan Tes Covid dan Vaksinasi

**naTTi Lab**  
*lab.inatti.id*

Mengelola database hasil Tes Covid-19 dan mempermudah pengelolan sampel secara real time

# 30 Besar Karya Terpilih Health Innovation 2023 Sprint Accelerator



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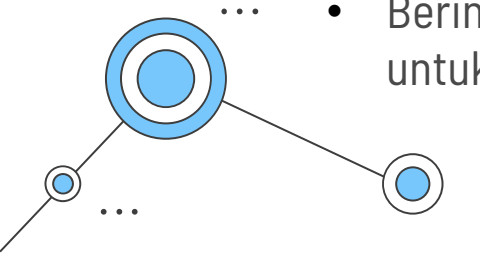
- 1 Healthpro.id
- 2 Automatic Record Triage Assistant (ARTA)
- 3 Platform Laboratorium Patologi Digital Terintegrasi
- 4 Prenatal Apps
- 5 I-Care
- 6 ATM Sehat Kit
- 7 Indonesia Test dan Telefarmasi (InaTTI)
- 8 Sepsis 360: Act Faster, Save Lives!
- 9 Farmasee
- 10 Clinical
- 11 FATKILLA
- 12 BioColoMelt-Dx
- 13 Healthcareku
- 14 Fungal Infections - In Vitro Diagnostics (IVD)
- 15 Medisin
- 16 HemoSense 3 in 1
- 17 Danova Home Care Solutions (DHCS)
- 18 Kemedis.co
- 19 KlinikGo
- 20 RADScan
- 21 Virtual Neuro Engineering and Restoration (VINERA)
- 22 CoFilm Antimicrobial Coating
- 23 Gizl Nusantara
- 24 PERIKSAIN
- 25 DubDub
- 26 Nexmedis
- 27 Dietela
- 28 Pembuatan dan Uji Coba Perencanaan Jarak Pemantauan Keluaran (PJK) Diagnostik Berbagai Penyakit di Indonesia
- 29 Jacket Carbon Cool
- 30 RDB2FHIR

# + Demo day





## Kesimpulan

- Masa depan Farmasi adalah digitalisasi
  - Farmasi Informatika dibutuhkan di era digitalisasi
  - Farmasi Informatika terbagi menjadi aspek science dan aspek pelayanan
  - Berinovasi dan berkarya untuk kemajuan farmasi
- 







# Haturnuhun

**Kontak kami**

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