

# Klinik Laboratuvarda R

# Uygulamaları

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BAŞKENT ÜNİVERSİTESİ TIP FAKÜLTESİ  
TIBBİ BİYOKİMYA AD

# SUNUM

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<https://github.com/ditopcu/whyR2022>



# Kısa Özgeçmiş

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- Tıp Doktoru (2004)
- Biyokimya Uzmanı (2009)
- Bilgisayar Mühendisi (2011)
-  kullanıcısı (2014 - ...)

# R Kullanıcısı

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→ Kapsamlı ve ücretsiz istatistik programı arayışı

→ useR 2017, Brüksel (Katılımcı)

→ Biyokimya uzmanlarına R kursu (2018)

→ RMed2021, Online (Poster)

→ R ile ilk denemeler 2015

<dplyr> ile tanışma, 2016

→ PhD için veri analizi, 2018

→ useR 2019, Toulouse (Lightning Talk)

→ **WhyR Türkiye (2022)**

WHY R?

# Klinik Laboratuvar İş Akışı



## Lab Report Template

Title: \* a brief, concise, yet descriptive title

Example: "Types of Invertebrates Found in Fresh Water"

Introduction: (State the problem or question to be answered)

\* What question(s) are you trying to answer?

\* Not all experiments start with a question, some start with an observation and questions develop from further observations

\* Include any preliminary observations or background information about the subject

Example: How many different types of insects are found in pond water? Does the location of the pond change the types of insects that live there? Does water quality affect the number of organisms?

Hypothesis:

\* Write a possible solution for the problem or an explanation for the observation

\* Make sure the possible solution is a complete sentence

\* Make sure the statement is testable, an if-then statement is recommended (builds what phrase will support your hypothesis and what data would not support the hypothesis)

\* Identify the manipulated (independent) variable and the responding (dependent) variable

Example: Frogs located near populated areas will have less exposure than ponds found in isolated areas

The manipulated variable is the pond location, the responding variable is the number of organisms

Materials:

\* Make a list of ALL items used in the lab. Alternatively, materials can be included as part of the procedure

Example: Fresh water, streamers, microscopes, field guides, petri dishes

Procedure:

\* Write a paragraph (complete sentences) which explains what you did in the lab as a short summary

\* You may choose to add details (step-by-step) of your procedure in such a way that anyone else could repeat the experiment

Example: Water was scooped from each pond and examined under the microscope. A field guide was used to identify the types of organisms found and estimations of numbers were recorded

Data:

\* This section should include any data tables, observations, or observations

\* You may attach a separate sheet(s) if necessary

\* All tables, graphs and charts should be labeled appropriately (X and Y axis)

Conclusions:

\* Accept or reject your hypothesis

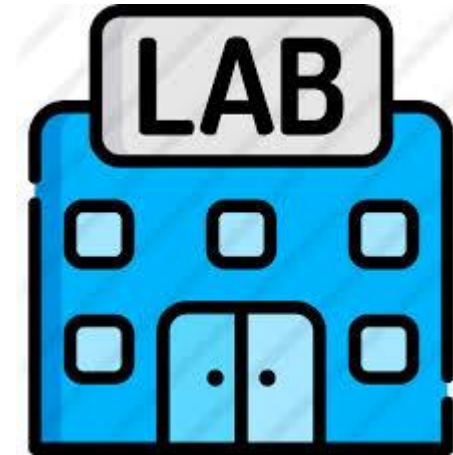
\* Explain why you accepted or rejected your hypothesis using data from the lab

\* Include a summary of the data - averages, highest, lowest, etc to help the reader understand your results. You may copy your data here, you should summarize and reference KEY information

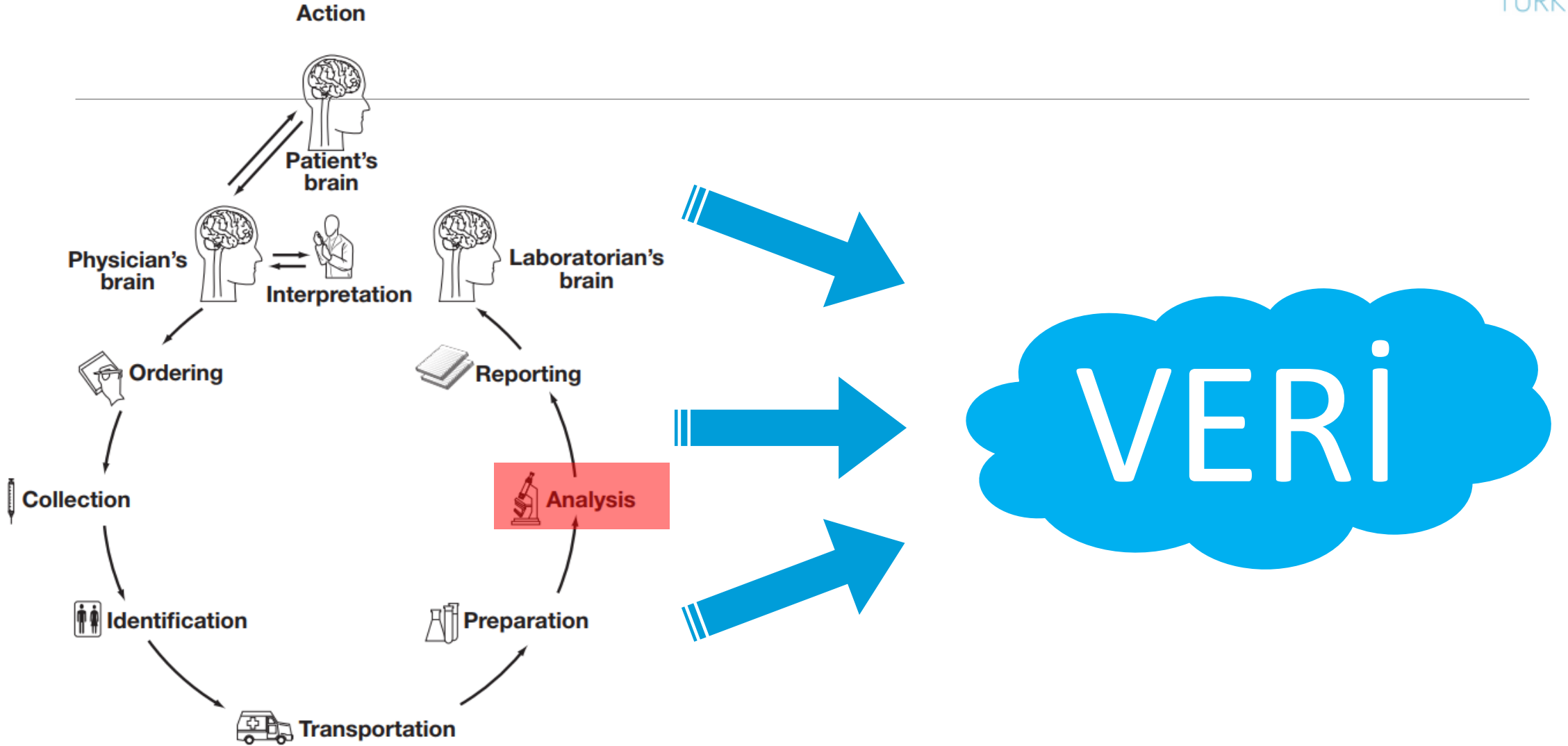
\* List one thing you learned and describe how it applies to a real-life situation

\* Discuss possible errors that could have occurred in the collection of the data (experimental errors) and suggest ways the experiment could be improved

For Grading: See Lab Report Rubric



# Klinik Laboratuvar İş Akışı



# Klinik Lab Veri Türleri

## Analitik Veriler

Hasta  
Sonuçları

Sayısal  
Grafik vb.

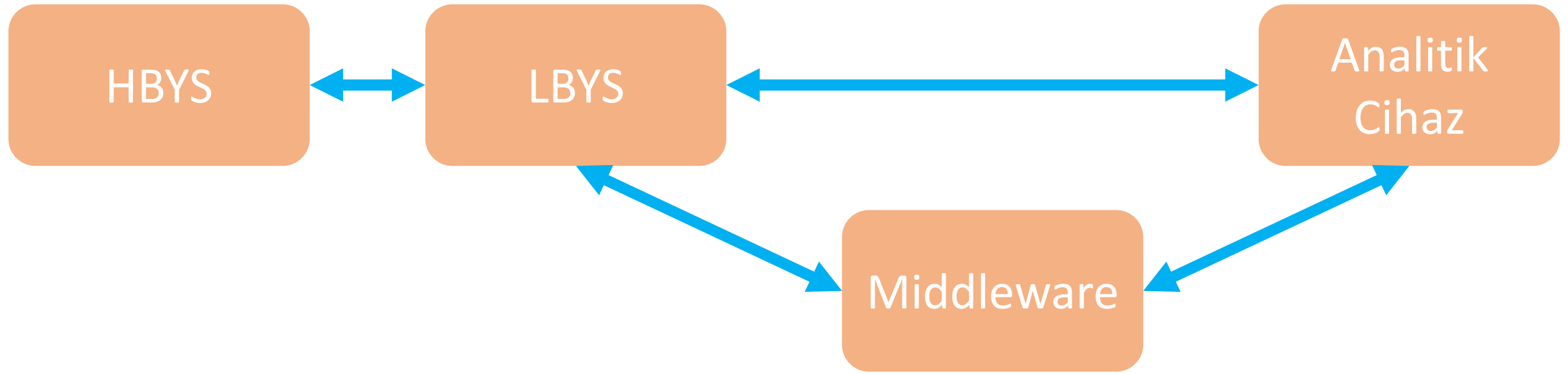
Diğer  
Ölçümler

- Kalite Kontrol (QC)
- Metot karşılaştırma
- Hasta temelli QC

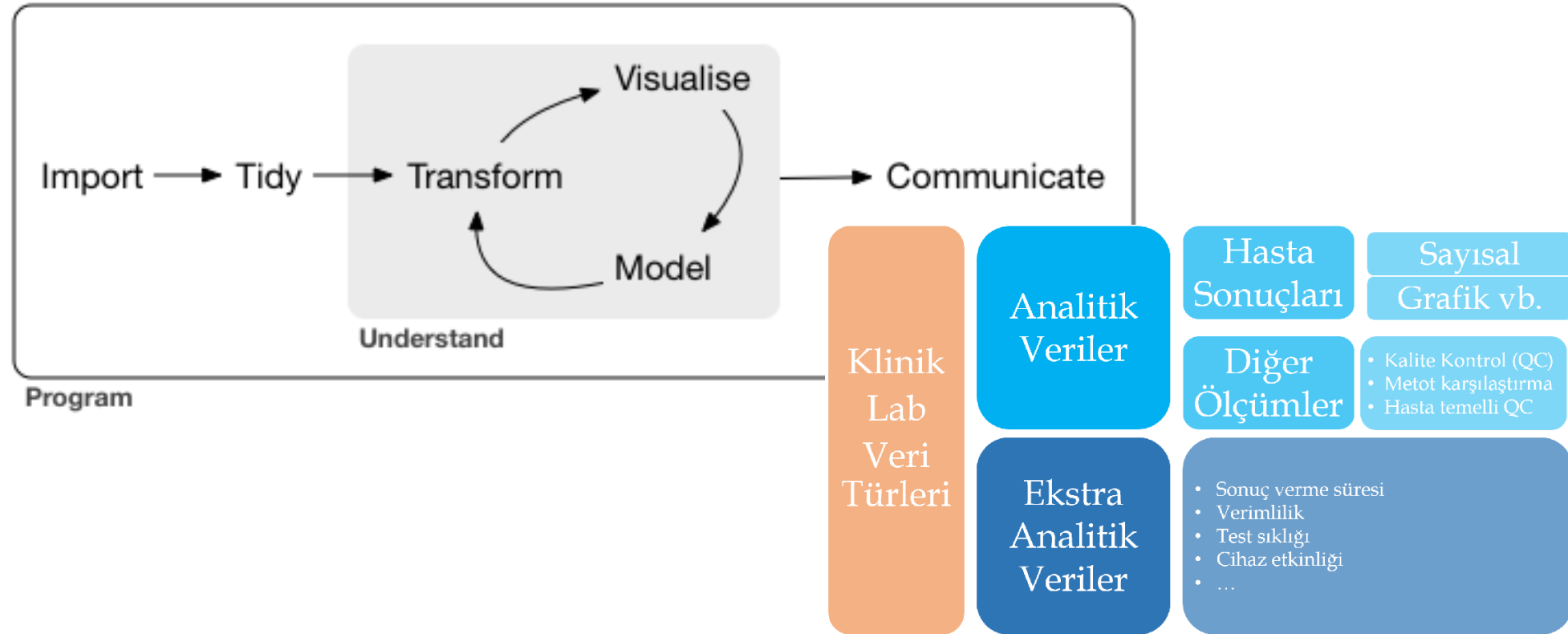
## Ekstra Analitik Veriler

- Sonuç verme süresi
- Verimlilik
- Test sıklığı
- Cihaz etkinliği
- ...





# Veri Bilimi İş Akışı



# Verinin «import» edilmesi -1

1. CSV, elektronik tablo programları
2. JSON dosyaları
3. Spesifik dosya formatları

## İlişkili Paketler:

- CSV import
  - base
  - data.table::fread()
  - vroom (Büyük veri)
- JSON
  - jsonlite

```
Sample ID;Sample Type;R/P;Module;Serial Number;RSM Position;Date of Completion;Time of Completion;Ope  
ID;Released by;Transmission Status;Comment;Control Name;Control Level;Control Lot;Control Lot Expirat  
Name;Assay Number;Assay Version;Result;Control Range;Result Flags;RLU-  
(IA);Absorbance;mv;Dilution;Cuvette;Processing Codes;Error Description;Reagent Master Lot;Reagent Ser  
Number;Reagent Lot Expiration;Calibration Date;Calibration Time;Site Name;System Name;System Software  
0110072101;Control;M4437/1;1;AC01314;1/9;22.12.2021;09:07;Admin;Admin;Transmitted;;MCHEM  
S;LEVEL1;011007210;31.12.2023;AlbuminBCG;1215;4;3.0  
g/dL;;;0.6402;;STANDARD;12;;;44332UN21;11303;09.06.2023;13.12.2021;08:07;;Alinity ci-series;3.3.2  
0110072101;Control;M4437/1;1;AC01314;1/9;22.12.2021;09:08;Admin;Admin;Transmitted;;MCHEM  
S;LEVEL1;011007210;31.12.2023;Amylase;1028;5;42  
U/L;;;0.0124;;STANDARD;105;;;59608UQ04;05094;07.10.2023;11.12.2021;12:58;;Alinity ci-series;3.3.2  
0110072101;Control;M4437/1;1;AC01314;1/9;22.12.2021;09:09;Admin;Admin;Transmitted;;MCHEM  
S;LEVEL1;011007210;31.12.2023;CL-C;1103;5;80  
mmol/L;;;3.7003;STANDARD;13;;;75825UN21;01856;15.07.2023;22.12.2021;07:24;;Alinity ci-series;3.3.2  
0110072101;Control;M4437/1;1;AC01314;1/9;22.12.2021;09:09;Admin;Admin;Transmitted;;MCHEM  
S;LEVEL1;011007210;31.12.2023;Na-C;1101;5;123  
mmol/L;;;3.8148;STANDARD;13;;;75825UN21;01856;15.07.2023;22.12.2021;07:24;;Alinity ci-series;3.3.2  
0110072101;Control;M4437/1;1;AC01314;1/9;22.12.2021;09:09;Admin;Admin;Transmitted;;MCHEM  
S;LEVEL1;011007210;31.12.2023;K-C;1102;5;2.9
```



```
A tibble: 2,377 x 37  
`Sample ID` `Sample Type` `R/P` Module `Serial Number` `RSM Position` `Date of Completion`  
<chr> <chr> <chr> <chr> <chr> <chr> <chr>  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072102 Control M4437/2 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
0110072101 Control M4437/1 1 AC01314 1/9 22.12.2021  
... with 2,367 more rows, and 29 more variables: Operator ID <chr>, Released by <chr>, Transmi  
Comment <lg1>, Control Name <chr>, Control Level <chr>, Control Lot <chr>, Control Lot Expir  
Assay Name <chr>, Assay Number <chr>, Assay Version <chr>, Result <chr>, Control Range <lg1>  
Result Flags <chr>, RLU- (IA) <lg1>, Absorbance <chr>, mv <chr>, Dilution <chr>, Cuvette <ch  
Processing Codes <chr>, Error Description <lg1>, Reagent Master Lot <chr>, Reagent Serial Nu  
Reagent Lot Expiration <chr>, Calibration Date <chr>, Calibration Time <chr>, Site Name <lg1>  
System Name <chr>, System Software Version <chr>
```

# Spesifik Dosya Formatları

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- Flow Cytometer
- Mass Spectrometry

## İlişkili Paketler:

- Flow Cytometer
  - beadplexr
  - IFC
- Mass Spectrometry
  - protViz

# Verinin Analize Hazırlanması

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- Gerekli sütunların seçimi  
(yaş, cinsiyet, test, test sonuç, ...)
- Filtreleme işlemleri  
(Kan şekeri < 50 mg/dL olanlar)
- Geniş ↔ Uzun veri dönüşümü
- Diğer veri temizliği işlemleri

## İlişkili Paketler:

- base
- dplyr
- purrr
- janitor

```
A tibble: 2,377 x 37
  `Sample ID` `Sample Type` `R/P` Module `Serial Number` `RSM Position` `Date of Completion`
  <chr>        <chr>        <chr> <chr>    <chr>          <chr>          <chr>
1 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
2 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
3 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
4 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
5 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
6 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
7 0110072102 Control      M4437/2 1 AC01314      1/9          22.12.2021
8 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
9 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
10 0110072101 Control      M4437/1 1 AC01314      1/9          22.12.2021
... with 2,367 more rows, and 29 more variables: Operator ID <chr>, Released by <chr>, Transmi
Comment <lg>, Control Name <chr>, Control Level <chr>, Control Lot <chr>, Control Lot Expir
Assay Name <chr>, Assay Number <chr>, Assay Version <chr>, Result <chr>, Control Range <lg>
Result Flags <chr>, RLU- (IA) <lg>, Absorbance <chr>, mv <chr>, Dilution <chr>, Cuvette <ch
Processing Codes <chr>, Error Description <lg>, Reagent Master Lot <chr>, Reagent Serial Nu
Reagent Lot Expiration <chr>, Calibration Date <chr>, Calibration Time <chr>, Site Name <lg>
System Name <chr>, System Software Version <chr>
```

```
QC_data <- raw_data |>
  select(serial_number, control_name, control_lot, control_level, assay_name, result ) |>
  separate(result, into = c("result_num", "unit"), sep = " ") |>
  mutate(result_num = parse_double(result_num))
```

```
> QC_data
# A tibble: 2,377 x 7
# Groups:   control_level, assay_name [64]
  serial_number control_name control_lot control_level assay_name result_num unit
  <chr>          <chr>        <chr>    <chr>          <chr>      <dbl> <chr>
1 AC01314      MCHES S      011007210 LEVEL1      AlbuminBCG      3 g/dL
2 AC01314      MCHES S      011007210 LEVEL1      Amylase         42 U/L
3 AC01314      MCHES S      011007210 LEVEL1      Cl-C           80 mmol/L
4 AC01314      MCHES S      011007210 LEVEL1      Na-C          123 mmol/L
5 AC01314      MCHES S      011007210 LEVEL1      K-C           2.9 mmol/L
6 AC01314      MCHES S      011007210 LEVEL1      Calcium        6.5 mg/dL
7 AC01314      MCHES S      011007210 LEVEL2      AlbuminBCG     3.9 g/dL
8 AC01314      MCHES S      011007210 LEVEL1      Glucose        54 mg/dL
9 AC01314      MCHES S      011007210 LEVEL1      Glucose        52 mg/dL
10 AC01314      MCHES S      011007210 LEVEL1      Total Prot     4.5 g/dL
```

# Verinin Analiz Edilmesi

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- Klinik laboratuvara yönelik birçok fonksiyon
  - Metot karşılaştırma
  - Hasta temelli QC
  - Referans aralıkları
- Genel istatistiksel analizler

## İlişkili Paketler:

- **mcr**
- **blandr**
- **qcc**
- **referenceIntervals**

# Verinin Sunulması

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- PDF export
- Dashboard
- Word, Excel, Powerpoint hazırlanması

## İlişkili Paketler:

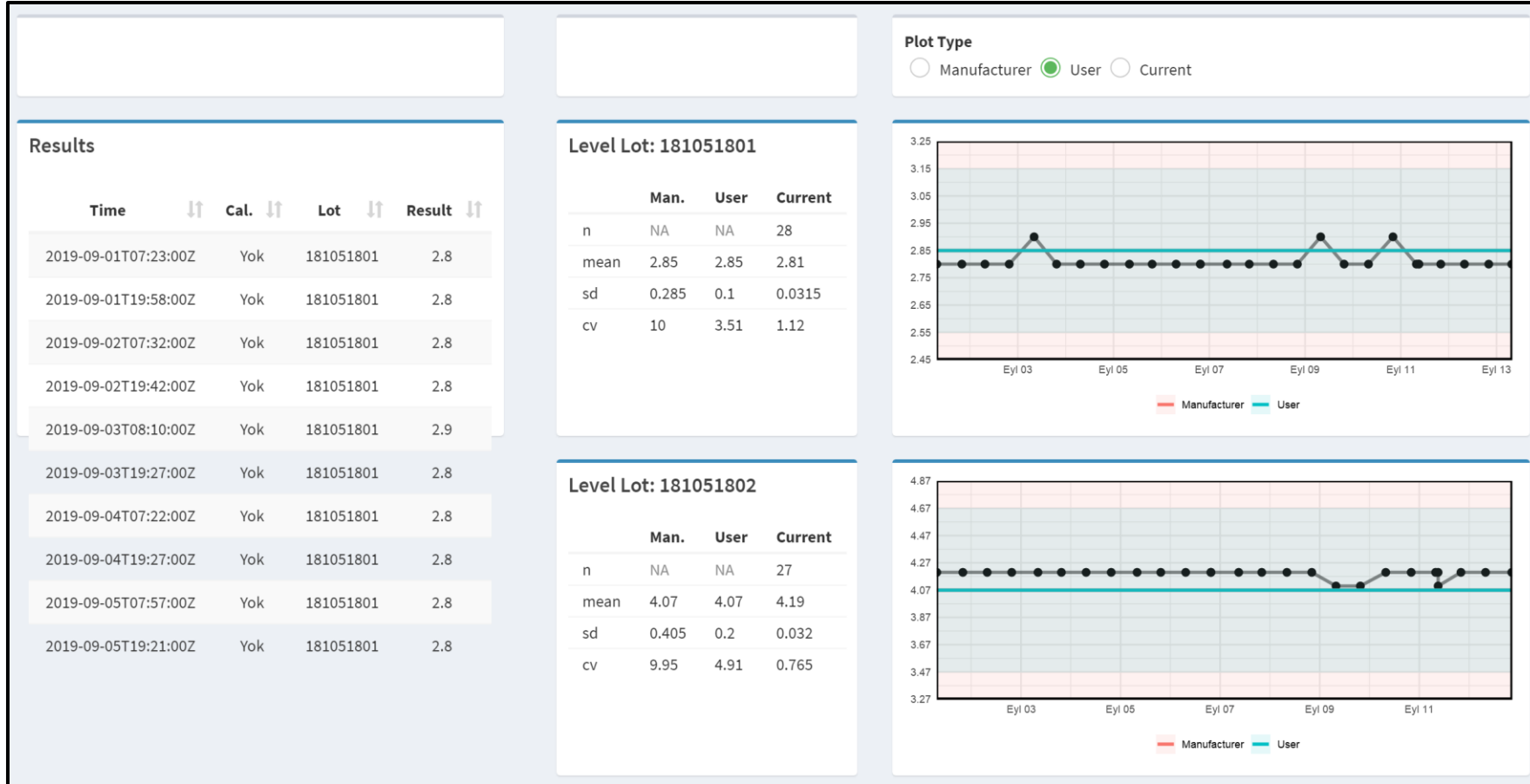
- **rmarkdown**
- **shiny**
- **officer**



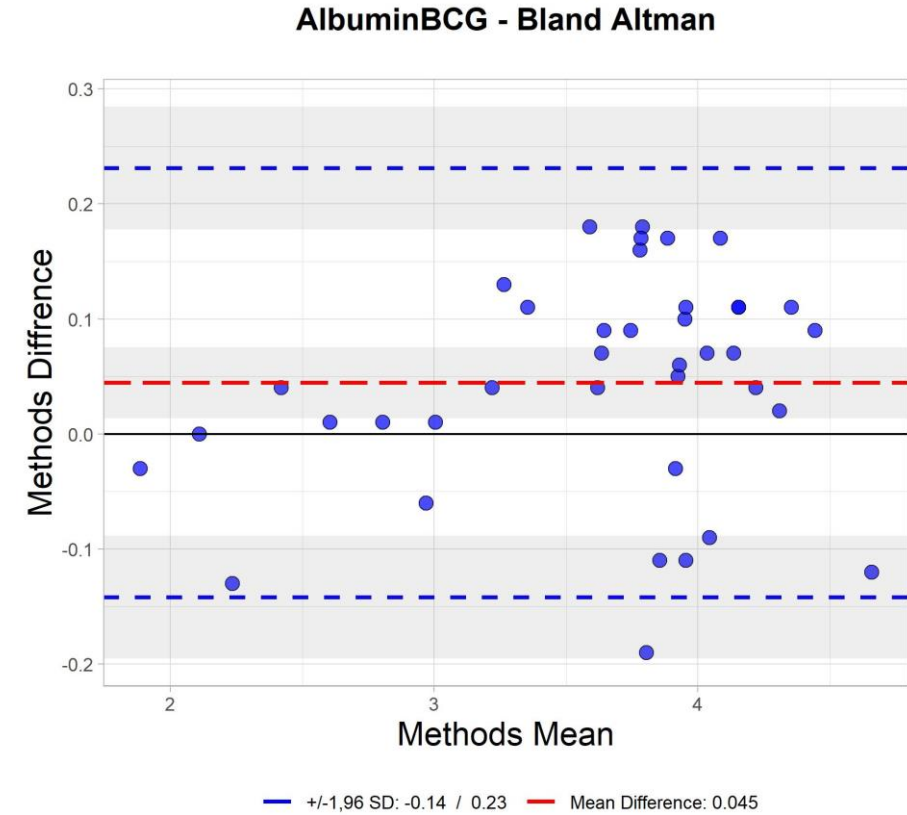
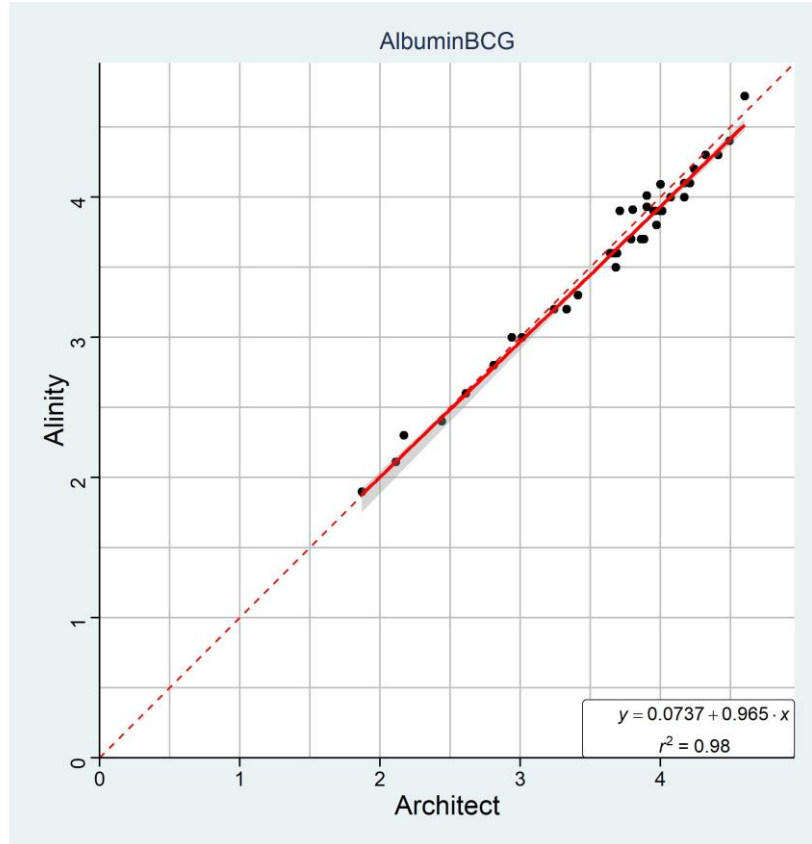
# R Kullanım Örnekleri

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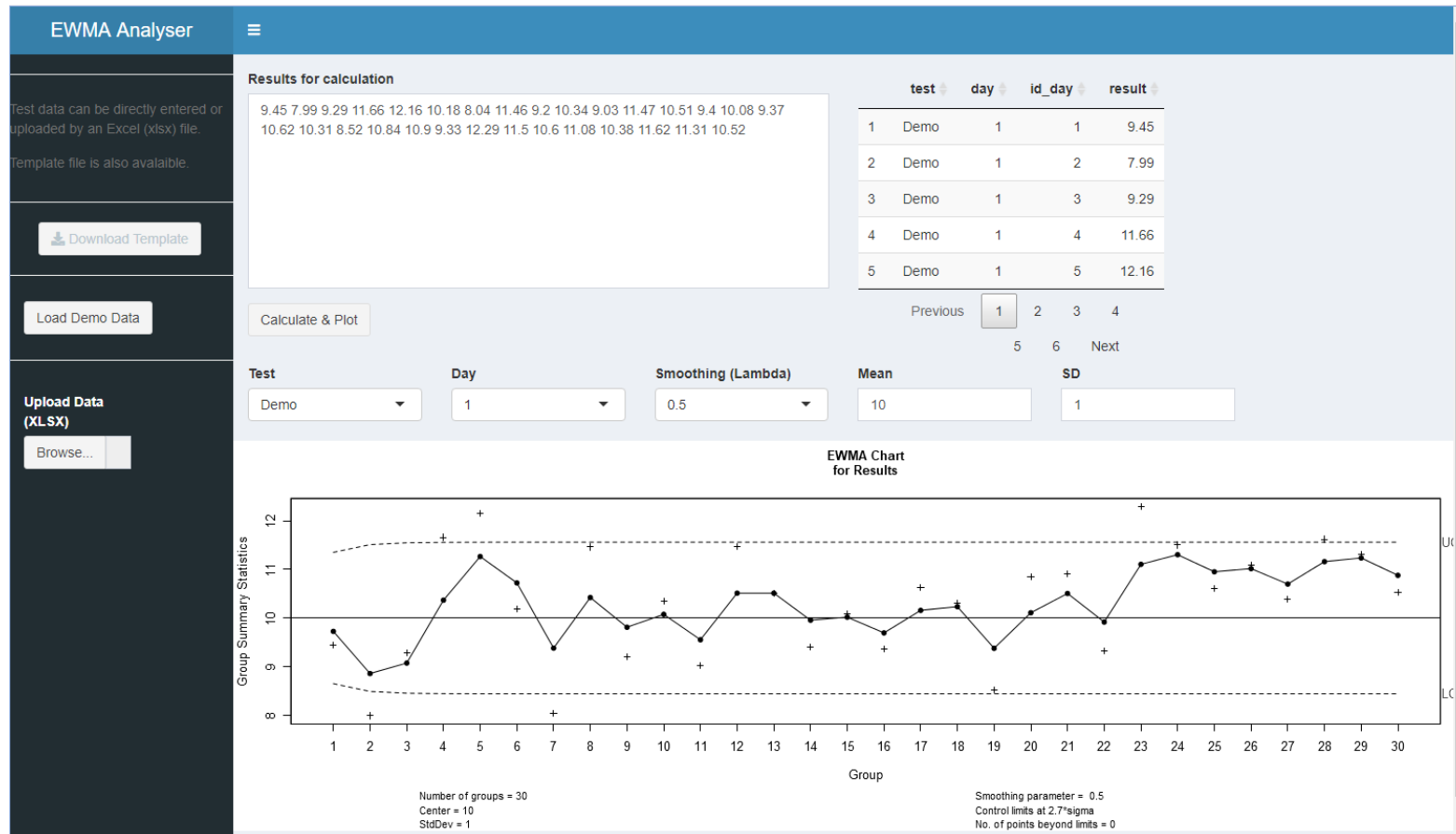
# Kalite Kontrol Sonuçları



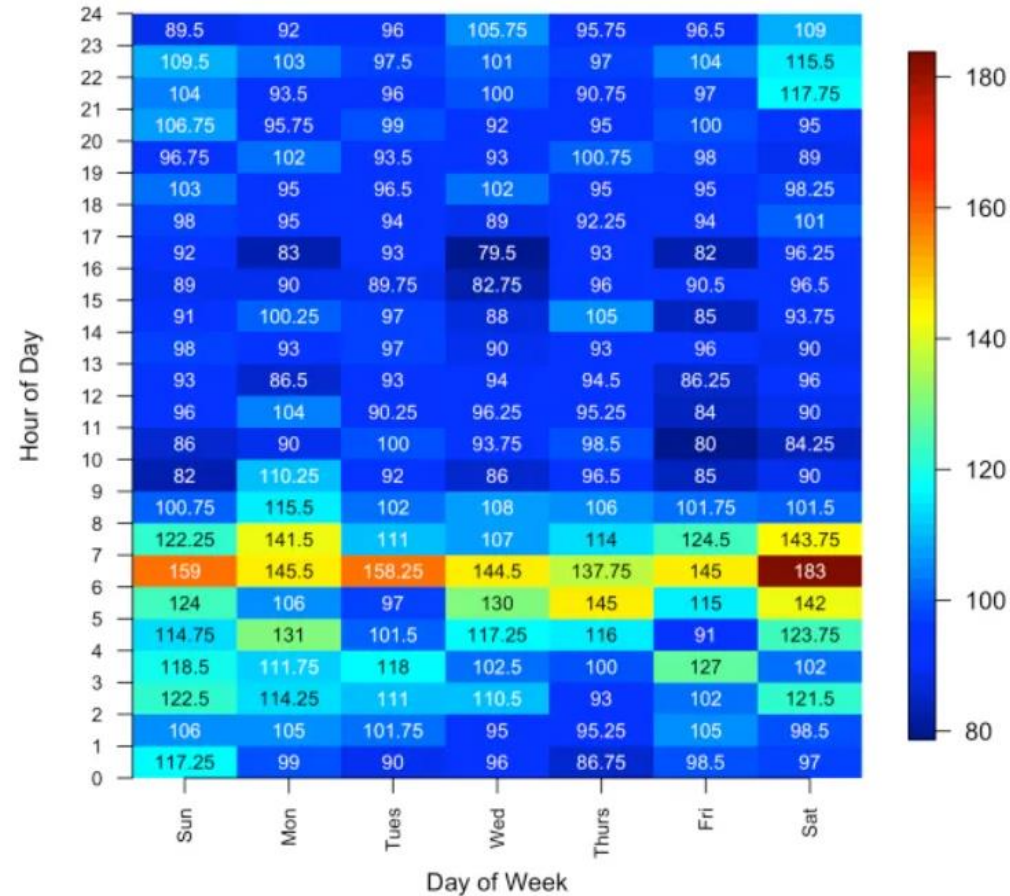
# Metot Karşılaştırma



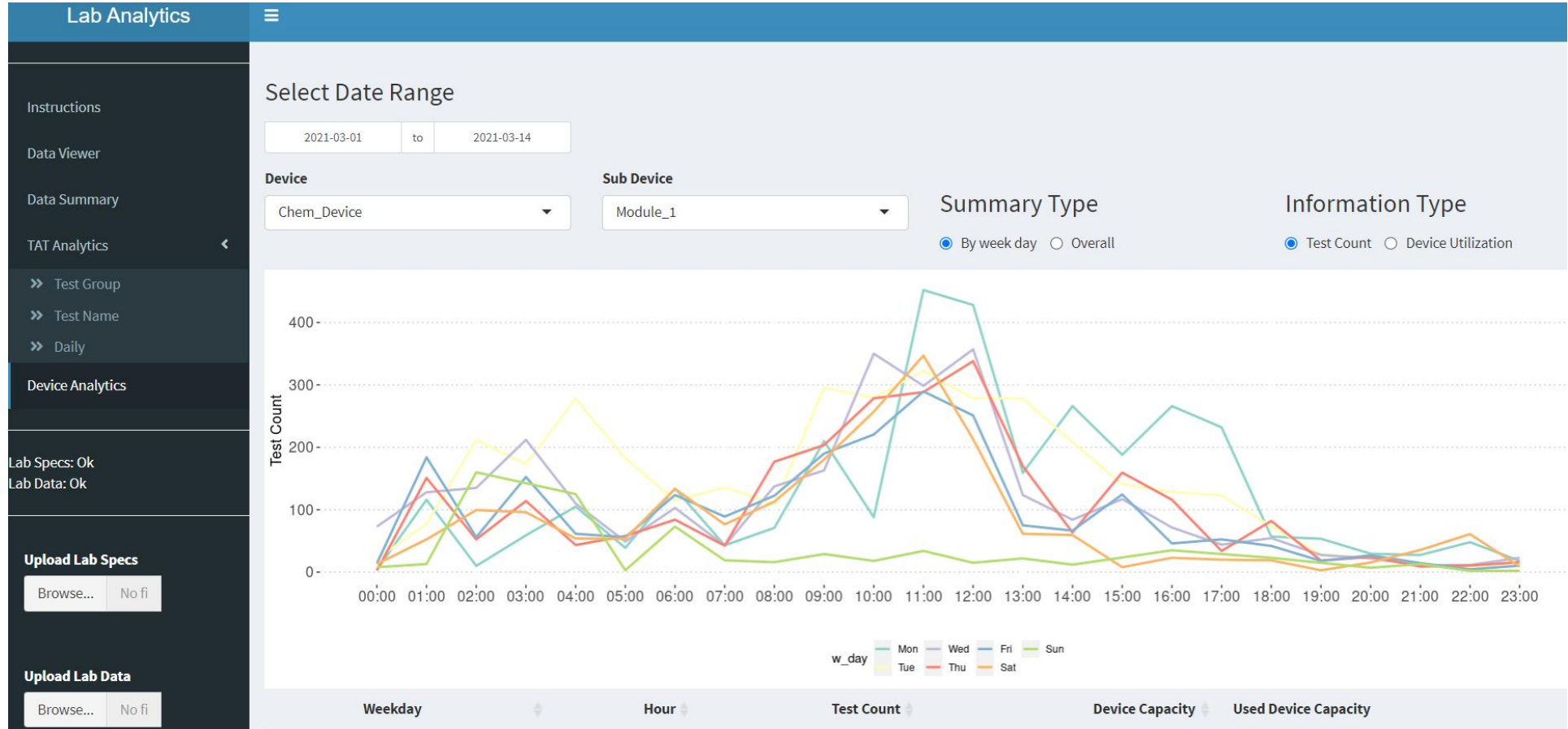
# Hasta Bazlı Kalite Kontrol



# Sonuç Verme Süresi Analizi



# Laboratuvar Veri Analitiği



# EUROMEDLAB 2021 ve R

Clinical Chemistry 66:8  
1072-1083 (2020)

Laboratory Management

## Understanding Patient-Based Real-Time Quality Control Using Simulation Modeling

Andreas Bietenbeck,<sup>a,\*</sup> Mark A. Cervinski,<sup>b,c</sup> Alex Katayev,<sup>d</sup> Tze Ping Loh,<sup>e</sup> Huub H. van R Tony Badrick<sup>h</sup> on behalf of the International Federation of Clinical Chemistry and Laboratory Committee on Analytical Quality

Clinica Chimica Acta 467 (2017) 70–82

Contents lists available at ScienceDirect

Clinica Chimica Acta

journal homepage: [www.elsevier.com/locate/clinchim](http://www.elsevier.com/locate/clinchim)



A global multicenter study on reference values: 1. Assessment of methods for derivation and comparison of reference intervals



Kiyoshi Ichihara<sup>a,\*</sup>, Yesim Ozarda<sup>b</sup>, Julian H Barth<sup>c</sup>, George Klee<sup>d</sup>, Ling Qiu<sup>e</sup>, Rajiv Erasmus<sup>f</sup>, Anwar Borai<sup>g</sup>, Svetlana Evgina<sup>h</sup>, Tester Ashavaid<sup>i</sup>, Dilshad Khan<sup>j</sup>, Laura Schreier<sup>k</sup>, Reynan Rolle<sup>l</sup>, Yoshihisa Shimizu<sup>m</sup>, Shogo Kimura<sup>a</sup>, Reo Kawano<sup>a,n</sup>, David Armbruster<sup>o</sup>, Kazuo Mori<sup>p</sup>, Binod K Yadav<sup>q</sup>, on behalf of, Committee on Reference Intervals and Decision Limits, International Federation of Clinical Chemistry and Laboratory Medicine:

# Kaynaklar ve Son Söz

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- [labrtorian.com/](https://labrtorian.com/)
- [nhsrcommunity.com/](https://nhsrcommunity.com/)
- [aacc.org](https://aacc.org)
- [github.com/ ditopcu/](https://github.com/ditopcu/)



## SORULAR ???

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[ditopcu@gmail.com](mailto:ditopcu@gmail.com)

