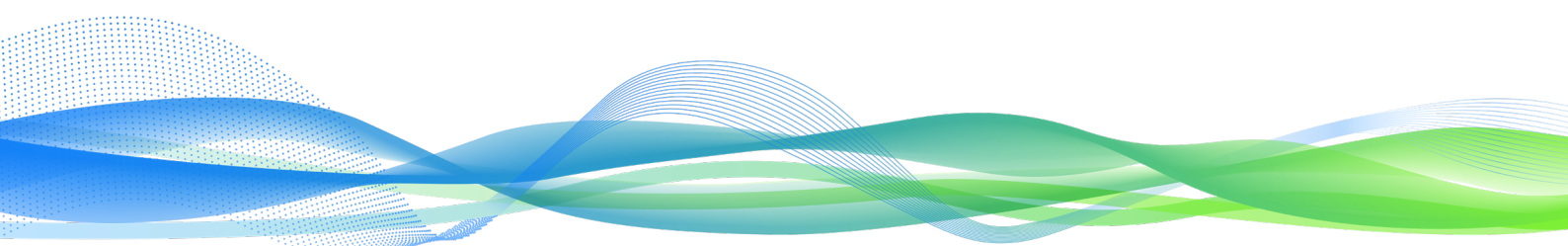# navify® Sample Tracking

Improving the pre-analytical pathway for medical laboratories

Executive summary

62% of errors occur prior to samples reaching the lab, a major pain point for laboratories and hospitals.[1] Additionally, manual data collection and paper records are inefficient and prone to errors.[2,3]

navify Sample Tracking is a cloud-based solution that directly interfaces with laboratory information systems (LIS) and pre-analytical solution providers in a fast and secure way.

By facilitating collaboration between pre-analytical solution providers and laboratories, **navify** Sample Tracking and its partner solutions reduce the rate of pre-analytical errors and the administrative burden for labs.

At the Center for Blood Coagulation Disorders and Transfusion Medicine (CBT) Bonn, **navify** Sample Tracking together with the S4DX system, a pre-analytical solution,

addressed 4 of the 8 most common pre-analytical errors reported in the literature. For example, patient identification was facilitated through digital barcode scans. Errors in inappropriate containers decreased from 0.34% to 0 errors for five consecutive quarters. Tube filling errors and missing test tubes errors decreased from 2.26% and 13.72% to 0% and 2.31% respectively in the final quarter.

Together, **navify** Sample Tracking and S4DX reduced pre-analytical errors, paper documentation, and improved workflow.

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Errors in laboratory diagnostics

Pre-analytical errors are the most common errors in laboratory practice

Laboratory testing is commonly divided into three phases matching the path a patient specimen follows once it has been collected: pre-analytical (prior to sample testing - includes all the steps from before sample collection to transportation and reception), analytical (during sample testing), and post-analytical (after the test result is generated).

The vast majority of laboratory errors, 62%, occur in the pre-analytical phase.[1] Pre-analytical errors occur around the time of test ordering, sample collection (including errors in patient identification, sample labelling and specimen collection), specimen transport, or specimen receipt in the laboratory.[4]

Contributing factors to pre-analytical errors are lack of process standardisation and automation, inappropriate staff training, and inappropriate documentation.[5]
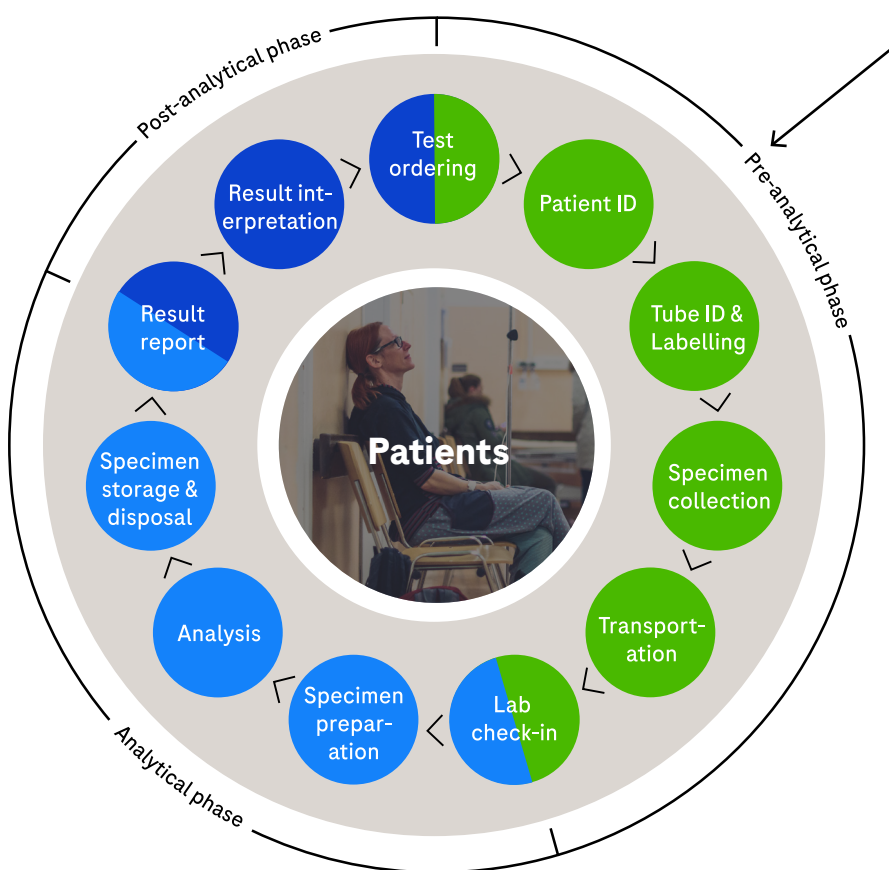
62% of errors occur in this phase.
This case study addresses four of the most common pre-analytical errors.[1,5]

Error type	Frequency (%)
Tube filling errors	13
Patient identification errors	9
Inappropriate container	8
Error in test request*	8
Empty tube	7
Missing tube	3
Non-refrigerated sample	2
Order misinterpreted	1
Other	11

* "Error in test request" refers to errors resulting from the wrong test being ordered and is equivalent to "Request procedure error" which is the term originally used in the publication.

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Pre-analytical errors are a significant problem in laboratory practice

Errors can have significant consequences for both laboratories and patients. For patients, an error may lead to the inconvenience of providing new samples. The patient may experience additional discomfort, decreased trust in the testing process and treatment delays.[6]

In the case of laboratories, errors affect the downstream analytical phase — re-sampling increases operating costs and decreases lab productivity. For example, in North American and European hospitals a single pre-analytical error on average costs US$ 206 and in total such errors account for approximately 0.7% of total operating costs.[7]

Despite these errors being outside of the laboratory's control, they have a significant impact and must be monitored in accordance with international quality standards for medical and clinical laboratories (ISO 15189).[8]

> *"The time is now for solving errors in the pre-analytical phase."*

Prof. Mario Plebani
Honorary Professor of Clinical Biochemistry
and Clinical Molecular Biology, University of Padova
and Adjunct Professor University of Texas

No single solution covers the complete pre analytical pathway

As the high frequency of pre-analytical errors is well known to the diagnostic industry, several companies have attempted to address these errors by offering digital solutions.

However, most pre-analytical solution vendors work within specific areas of the sample journey (e.g., sample collection, transport, and reception) and there is no single vendor covering the full pre-analytical journey of a patient sample. This poses a significant challenge for laboratories when trying to identify and manage the right combination of pre-analytical services to meet their sample workflow needs.[9]
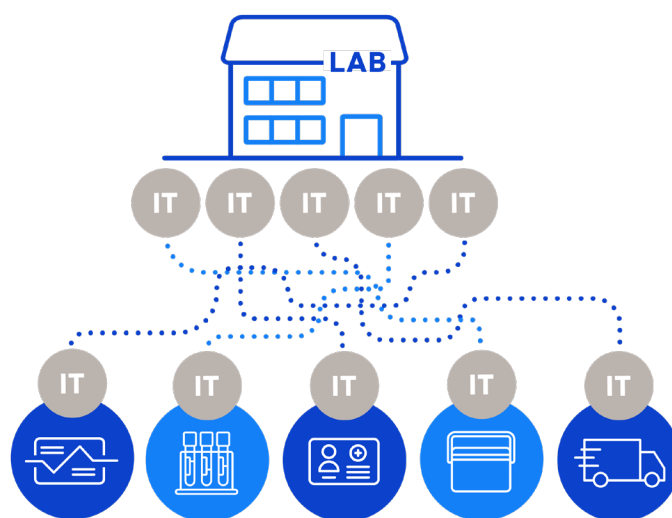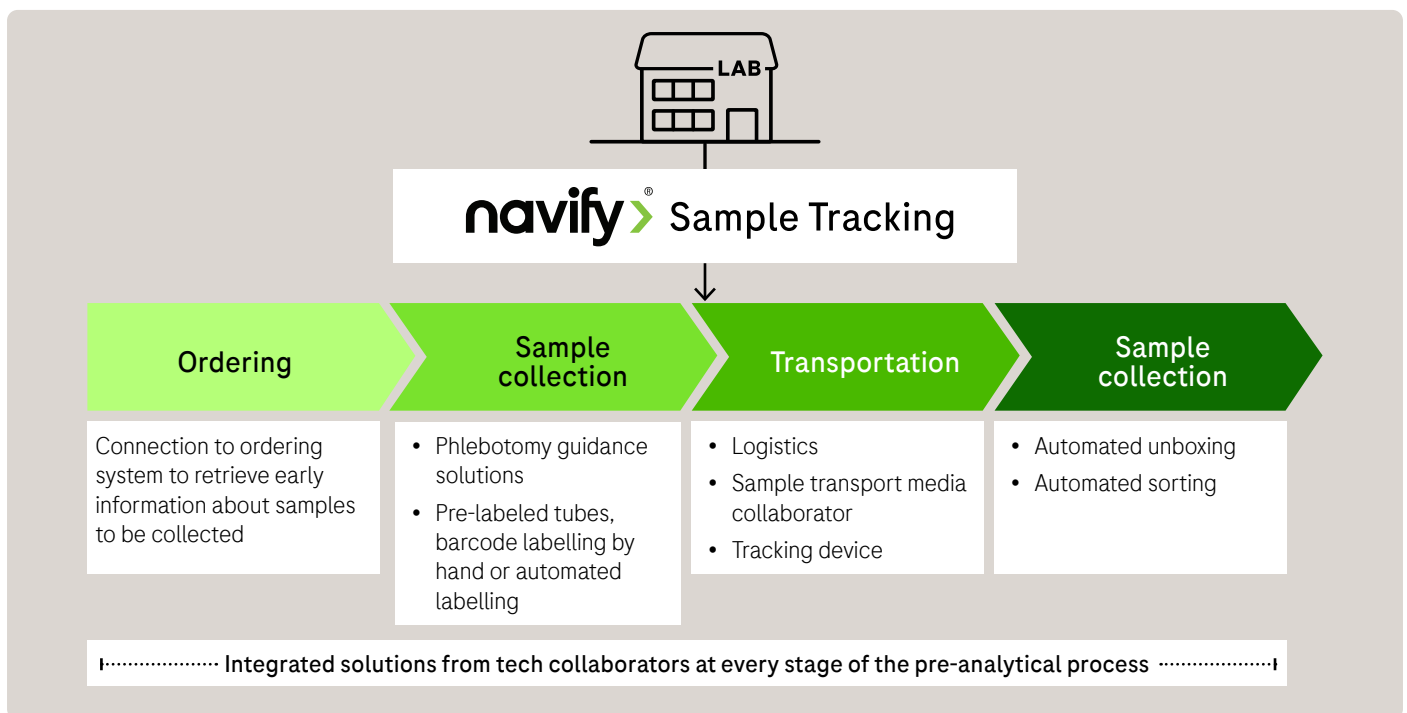
No single solution covers the entire
pre-analytical pathway

navify®

One digital solution for the entire pre-analytical pathway

navify® Sample Tracking

navify Sample Tracking is part of the **navify** Diagnostics portfolio, a set of digital solutions enabling labs to drive end-to-end operational excellence across care settings. It is a cloud-based solution that directly interfaces with laboratory information systems (LIS) and pre-analytical solution providers in a fast and secure way. Thus, it removes the need for the cumbersome process of laboratories individually integrating each new solution to their LIS.

LAB

navify® Sample Tracking

Ordering	Sample collection	Transportation	Sample collection
Connection to ordering system to retrieve early information about samples to be collected	• Phlebotomy guidance solutions • Pre-labeled tubes, barcode labelling by hand or automated labelling	• Logistics • Sample transport media collaborator • Tracking device	• Automated unboxing • Automated sorting

Integrated solutions from tech collaborators at every stage of the pre-analytical process

navify® Sample Tracking

Facilitates collaborations between pre-analytical solution providers and laboratories, making it simple for labs to connect multiple solutions specific to their needs.

Improves the quality, efficiency, and productivity of the laboratory by providing visibility into blindspots of pre-analytical procedures.

Collects and stores data from the complete journey of a sample in a centralised and easily accessible format for auditing.

navify®

Roche

Case study: CBT Bonn's experience with navify Sample Tracking and S4DX

Meet the customer

This case study describes the experience of the Center for Blood Coagulation Disorders and Transfusion Medicine (CBT) Bonn, Germany, where **navify** Sample Tracking was deployed together with a partner PPA solution provided by Smart4Diagnostics (S4DX).

The CBT is a 38 year old healthcare company with several Medical Care Centres and affiliated laboratories. It operates at six different sites in Germany, overall receiving samples from almost 3,000 doctors.

One of its centres is CBT Bonn, an interdisciplinary centre that offers outpatient services and laboratory medicine services (e.g., haematology, immunology, cytology, molecular diagnostics, endocrinology).

The blood sample workflow at this site is an end-to-end process, with the patient, phlebotomist, laboratory, and clinician all operating at the same centre. On average, the lab receives between 60 and 120 samples per day all coming from a single collection point.[10]

## Challenges faced by CBT Bonn prior to implementing navify Sample Tracking

Historically, the blood sample collection process at CBT Bonn was not digitised and relied on barcodes and hand written records that were manually digitised by highly trained in-house staff. This approach meant high personnel costs, limited ability to scale operations, and was prone to input errors.

The centre's interest in digitalising processes together with its end-to-end blood sample workflow provided the ideal environment to explore the benefits of linking a PPA solution to the CBT LIS through **navify** Sample Tracking.

"We see the comprehensive quality monitoring of the sample journey as an important contribution to value-based healthcare."

Dr. phil. André Körner
Head of Communication & Development, Center for Blood Coagulation Disorders and Transfusion Medicine
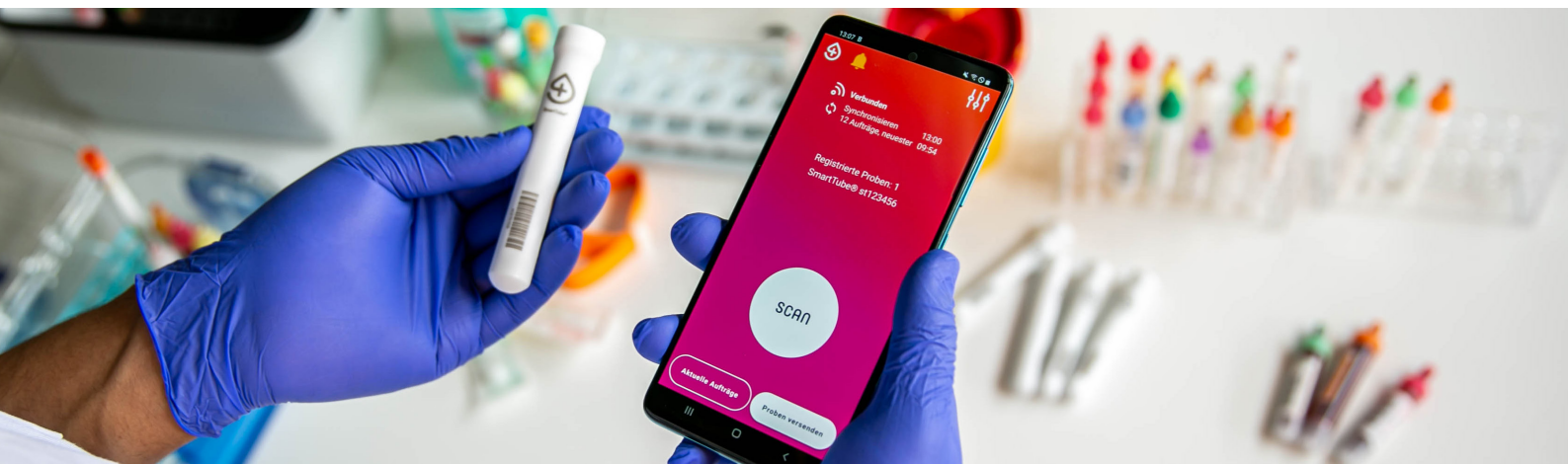
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The introduction of navify Sample Tracking and the S4DX system at CBT Bonn

navify Sample Tracking and S4DX system were introduced together in June 2021.

The German based company S4DX offers digital solutions for the pre-analytical phase. One of its solutions is the S4DX Satellite App and its equivalent for web browsers, the S4DX Browser Scan. This addresses errors occuring in the PPA phase, focused around the blood sample collection stage.

The S4DX system can identify and verify patients via a barcode scan of their wristband. After sample collection, the S4DX software confirms whether all order-related tubes have been registered and collects information from phlebotomists on sampling events (i.e., difficult blood flow during collection, filling volume of test tube). Additionally, the sample collection time is automatically recorded.

navify Sample Tracking connected the S4DX system and LIS, enabling data flow between the two systems. This way, information collected with S4DX on individual samples became available on the IT system of the lab to be used by the lab head or head of quality.

Data was collected from Q2 2021 until Q3 2023. During this time, 50,484 samples were processed using S4DX and **navify** Sample Tracking (Fig. 1).

During the three quarters after the introduction of S4DX and **navify** Sample Tracking (Q3 2021 to Q1 2022) significantly fewer samples were processed as efforts were focused on onboarding another CBT centre.

From Q2 2022 onwards, **navify** Sample Tracking and S4DX were used frequently for registering samples.
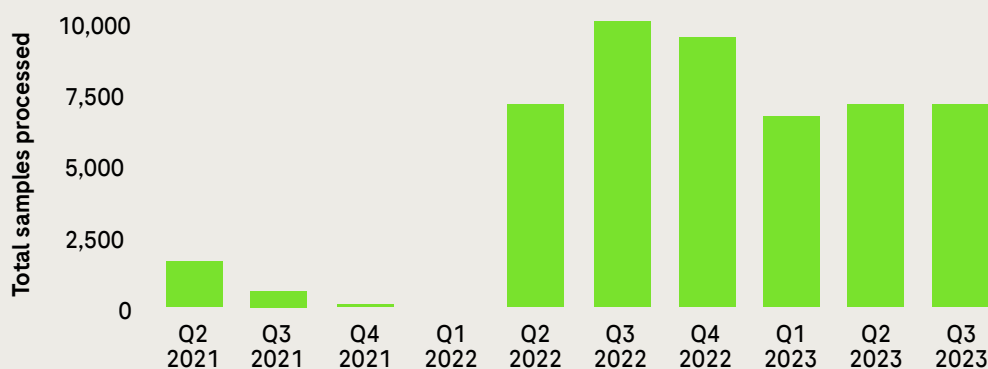

Fig. 1. Number of samples processed in each quarter.

Reduced errors and improved efficiency of laboratory processes

Through the S4DX system, the following information was collected and stored digitally: sample ID, patient ID confirmation, sample collection timestamp, order completion status, patient pre-draw status of blood pressure and sobriety, and sample quality indicators of filling volume, collection difficulties and missing sample due to stopped blood flow.

Prior to blood sample collection, the label barcode scan function of S4DX verified if the correct patient, order and container had been selected, so that any errors could be corrected immediately.

As **navify** Sample Tracking and S4DX became increasingly used, the error rates reported decreased. (Fig 2.) Errors in inappropriate containers decreased from 0.34% in Q2 2021, to no errors in the final five quarters. Tube filling errors decreased from 2.26% in Q2 2021 to less than 0.01%, while difficult collection errors decreased from 2.45% to less than 0.02%. The frequency of missing test tubes was reduced from 13.72% to 2.31% in the final quarter.

The automatically generated timestamp allowed CBT is to better comply with ISO15189 requirements related to recording order completion timestamp.

Thus, S4DX and **navify** Sample Tracking improved the workflow by reducing the amount of paper documentation performed at the centre, automating quality assurance, and reducing order misinterpretation.

In addition, the head of Communications and Development at CBT Bonn, in charge of the digitisation initiative at the centre felt that **navify** Sample Tracking was simple to use and provided useful information to the laboratory. Furthermore, the digital documentation offered through **navify** Sample Tracking reduced the number of manual tasks contributing to the centre's efficiency.

Inappropriate container errors:
0.34%
⬇**0%**

Tube filling errors:
2.26%
⬇**0%**

Difficult collection:
2.45%
⬇**0.02%**

Missing tube errors:
13.27%
⬇**2.31%**
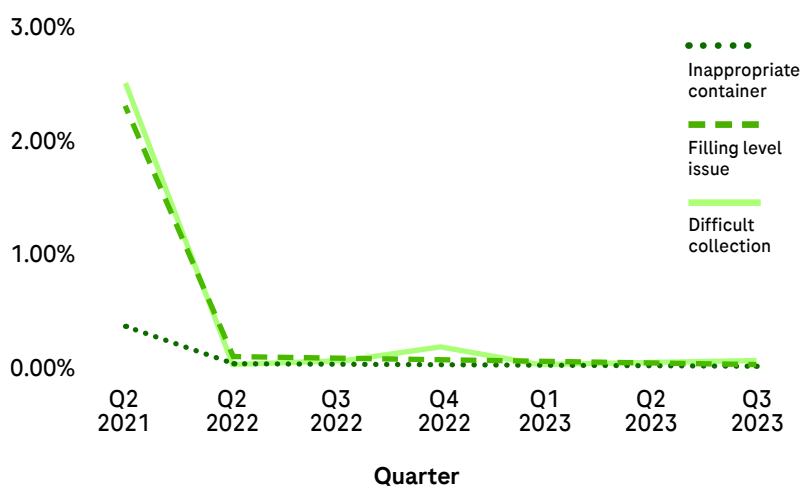
Fig. 2. Error frequency in each quarter.
Note: In Q3 and Q4 2021 few samples were processed using S4DX and navify Sample Tracking. In Q1 2022 no samples were processed.

"Good samples make good assays."

Prof. Mario Plebani
Honorary Professor of Clinical Biochemistry
and Clinical Molecular Biology, University of Padova
and Adjunct Professor University of Texas

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navify Sample Tracking will aid CBT Bonn in its future ambitions

The implementation of **navify** Sample Tracking together with the S4DX System at CBT Bonn demonstrated the benefits of easily integrating PPA solutions with the LIS. Even a single PPA solution vendor collecting data digitally provided significant value to the sample workflow at CBT Bonn.

Improved visibility into the sample collection process allowing for quicker and more efficient detection and resolution of issues, as demonstrated at CBT Bonn, will be invaluable for other CBT centres as CBT expands its operations to additional sites.

Additionally, CBT will be able to explore trends within the collected data, for example identify potential correlations between phlebotomy notes and the diagnostic results, compare error rates between different locations and the distribution of workload throughout the month. These insights, together with the reduction of unnecessary costs and the improved diagnostic process will help CBT establish the gold standard for laboratory medicine.[11] The head of the CBT laboratory recognised the value of this collaboration, describing the digital data collected as "gold" for their laboratory operations.[9]

navify › Sample Tracking

Do you want greater control over the pre-analytical process?

With **navify** Sample Tracking you can easily customise your pre-analytical workflow by integrating multiple pre-analytical solution providers with your LIS. This way, you gain additional insights into the pre-analytical pathway of samples, with less effort.

Fewer errors result in lower costs and digitalisation of lab processes can lead to operational efficiencies, ultimately improving the quality of results delivered to patients.

If you are interested in **finding out more** about **navify** Sample Tracking, or would like to implement it at your centre, please get in touch.

With navify Sample Tracking you could potentially...

Lower costs through fewer errors

Improve lab efficiency through digitalisation

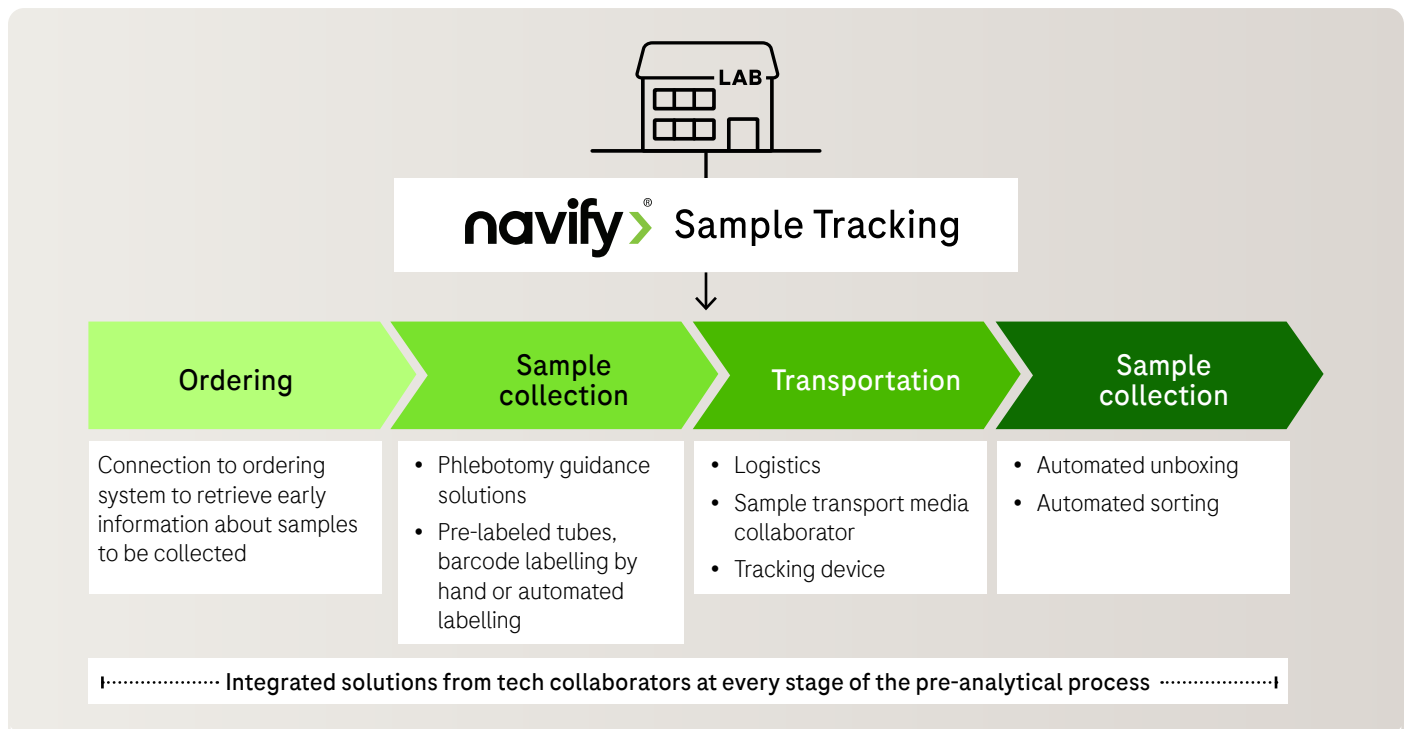**Improve lab processes** through data driven insights

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References

1. Cadamuro J, Gaksch M, Mrazek C, Haschke-Becher E, Plebani M. How do we use the data from pre-analytical quality indicators and how should we. J Lab Precis Med. 2018;3(6).

2. Das D, Pal K, Roy S, Lodh M. Risk identification of a hospital laboratory pre-analytics through failure mode and effect analysis. Asian Journal of Medical Sciences. 2021 Apr 1;12(4):31-8.

3. Lippi G, Mattiuzzi C, Favaloro EJ. Artificial Intelligence in the pre-analytical phase: state-of-the art and future perspectives. Journal of Medical Biochemistry. 2023 Aug 29.

4. Hammerling JA. A review of medical errors in laboratory diagnostics and where we are today. Laboratory medicine. 2012 Feb 1;43(2):41-4.

5. Carraro P, Plebani M. Errors in a stat laboratory: types and frequencies 10 years later. Clinical chemistry. 2007 Jul 1;53(7):1338-42.

6. Iqbal MS, Tabassum A, Arbaeen AF, Qasem AH, Elshemi AG, Almasmoum H. Preanalytical errors in a hematology laboratory: an experience from a tertiary care center. Diagnostics. 2023 Feb 6;13(4):591.

7. Green SF. The cost of poor blood specimen quality and errors in preanalytical processes. Clinical biochemistry. 2013 Sep 1;46(13-14):1175-9.

8. International Organization for Standardization. Medical laboratories: requirements for quality and competence. ISO 15189:2022.

9. MC-DE-01751 An integrated pre-pre-analytic solution to phlebotomy support and more

10. Center for Blood Coagulation Disorders and Transfusion Medicine [Internet]. [cited 2023 Nov 16]. Available from: https://www.cbtmed.de/das-cbt/

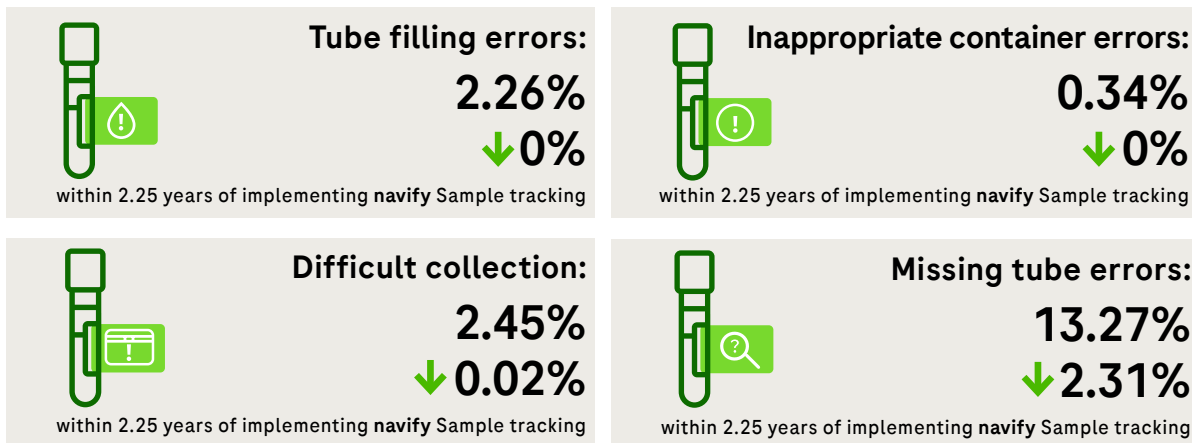11. Newe Wege Zur Evidentz. Starkes Land Nordrhein-Westfalen [Internet]. 2023 Nov. [cited 2023 Dec 1]; [16 p]. Available from: https://ablingergarber.com/themenmagazin/nordrhein-westfalen-starkes-land/

navify® Sample Tracking

Improving the pre-analytical pathway for medical laboratories

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Integrated solutions from tech collaborators at every stage of the pre-analytical process

At the center for Blood Coagulation Disorders and Transfusion Medicine (CBT) Bonn...

navify Sample Tracking together with the S4DX system, a pre-analytical solution, reduced pre-analytical errors, paper documentation, and improved workflow at the centre over two years.

Together they addressed 4 of the common pre-analytical errors reported in the literature.[1]

Tube filling errors:
2.26%
↓**0%**
within 2.25 years of implementing **navify** Sample tracking

Inappropriate container errors:
0.34%
↓**0%**
within 2.25 years of implementing **navify** Sample tracking

Difficult collection:
2.45%
↓**0.02%**
within 2.25 years of implementing **navify** Sample tracking

Missing tube errors:
13.27%
↓**2.31%**
within 2.25 years of implementing **navify** Sample tracking

1. Paolo Carraro, Mario Plebani, Errors in a Stat Laboratory: Types and Frequencies 10 Years Later, Clinical Chemistry, Volume 53, Issue 7, 1 July 2007, Pages 1338–1342, https://doi.org/10.1373/clinchem.2007.088344