Norwegian EHR Market Analysis

A report for The Norwegian Directorate of e-health

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Executive Summary

The Directorate of e-health engaged Gartner to conduct this electronic health record (EHR) market analysis to provide an overview of the local and international vendors and solutions that are available for Norwegian healthcare providers. The objective of this report is to provide an up-to-date overview of the current EHR market situation in Norway.

This report is based on the responses vendors provided to an EHR market survey conducted between December 2022 and February 2023. The analysis of these vendor responses is shown in *Chapter 2. Overview of the current Norwegian EHR market*. In 2014, Gartner conducted a similar market survey in the Norwegian EHR market, outlining the vendor presence and key development areas at that time. This report also utilizes the findings of the previous report to reflect changes in the market since 2014. Finally, this report analyses current developments in the global EHR market to provide a wider context to complement the vendor provided information.

This report has found several themes that have driven development of the market, including meeting changing user needs, adoption of technological advancements, developments specific to the Norwegian market and market entry of new vendors and products. This report identifies the following key developments across these themes:

- *The Norwegian EHR market has expanded with new EHR vendors.* There are no longer a few vendors that dominate the market, although some vendors still hold the majority of market share within particular user segments. In general, a more competitive market provides more flexibility for the customer organizations to select the solution that best meets their needs. When looking at the broader market, by including the various types of EHR solutions targeted at different user segments, it is clear that the EHR options available to customer organizations have increased.

- *New product offerings are being introduced in the market by both established vendors and new entrants.* These products are based on modern technologies, such as web-based Software as a Service (SaaS) solutions.

- *Cloud-based solutions are becoming increasingly popular in Norway as well as globally.* This is leading to a shift away from on-premises solutions. Although on-premises based delivery models are still most widely supported for EHR products, vendors are eager to further develop their cloud-based product offerings and migrate customers from their legacy solutions into modern, SaaS-based options.

- *Vendors are increasingly in compliance with standards to enable interoperability* for data sharing between systems and other sources such as medical devices and sensors.

- *Norway leads the way as one of the leading hot spots for openEHR adoption.* This is occurring through openEHR projects and definition work through Clinical Knowledge Management (CKM). The maturity of the market is well acknowledged, and Norway is seen as a test bed for less mature markets.

- *The EHR market covers fundamental capabilities though gaps remain for additional capabilities.* The capabilities that are considered as fundamental, regardless of the use case, are widely covered by the solutions available in the market. However, there may be a lack of coverage for additional capabilities (features/functionality) to meet the specific needs of certain user groups or use cases.

- *Global EHR vendors have entered the Norwegian market.* Since 2014, megasuites such as Epic (through Helseplattformen) and other larger European EHR solution vendors (some of which are headquartered in other Scandinavian countries) have entered the Norwegian market.

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- *Developments in prescriptive and insightful intelligence will increasingly advance clinical practices.* Prescriptive and insightful intelligence will also streamline and predict demand for care services, assign appropriate care pathways and help make treatment recommendations (e.g., advanced clinical decision support, CDS).

- *Improved clinical communication and collaboration tools are advancing the clinical experience.* This leads to less onerous and more convenient collaboration among care team members. This, in turn, will enhance the EHR user experience, support mobile GPs, and reduce EHR-related physician burnout. With access to the EHR from any workstation or mobile device, the care team can locate and review patient information wherever they are located.

- *Enhancements in virtual visits, remote patient engagement and continuous monitoring, will further reduce unnecessary care.* More patients can thus be seen promptly at the right time, at the right place and with the right expert for the right condition.

Overall, the Norwegian market, a vibrant yet mature environment of multiple vendors, consists of a wide range of solutions that target different user segments with a varying level of functional capabilities. The market is also experiencing a growing interest from foreign vendors who are looking to either enter or expand their presence. The findings of this report suggest that there is potential for development to improve the capabilities (functional and non-functional) of EHRs for primary care and outpatient use cases, as well as increasing the availability and adoption of modern, modular, and cloud hosted EHRs.

It is important to note that this report only reflects the responses that EHR vendors provided to each vendor questionnaire. Therefore, the report only captures the perspective of the EHR vendors and their reflections of the capabilities they offer. As such, it is important to note that the actual implementation and adoption of these solutions experienced by healthcare delivery organizations may vary. It is possible that some solutions may not fully meet the needs and expectations of healthcare providers, leading to lower productivity and decreased user satisfaction among other things. Therefore, further analysis from the perspective of the user will be important to better understand the users' requirements/needs when it comes to EHR solutions and EHR solutions' capabilities.

Additionally, further investigation is needed to identify any potential barriers to adoption and implementation of EHR solutions by healthcare organizations. Barriers may include migration costs, technical requirements, data lock-in, user support, and local adaptation of each product. By addressing these barriers and any others, it should be possible to increase adoption rates and improve the overall effectiveness of EHR solutions supporting the delivery of healthcare services.

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Norwegian EHR Market Analysis

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1.   Introduction

1.1.   Background of the report

The Directorate of e-health has engaged Gartner to conduct an EHR market survey on their behalf. The market survey includes local and international vendors that are delivering, or intend to deliver, EHR solutions and services to Norwegian healthcare providers.

The objective of this report is, based on the responses to the survey, to provide an updated overview of the current EHR market situation, including recent changes and expected future development of the market in Norway. The questions this report seeks to answer include, but are not limited to:

1) What EHR solution vendors (including patient registry) are currently present in the market and is there any foreseeable interest from international vendors to enter the market?

2) What are the development focus areas for vendors present in the Norwegian market and are there differences with those development areas observed among EHR vendors globally?

3) What capabilities and functionality do the current EHR products offer to primary care providers in Norway?

4) Are there global development trends that the Norwegian authorities should consider in their decision making going forward?

The findings presented in this report are intended to provide background information for further national decision making, such as:

- Updating the e-health policies in Nasjonal helse- og samhandlingsplan (NHSP)

- Realizing the new national e-health strategy

- Further design of the Helseteknologiordningen.

This report has been conducted between 20.12.2022 and 20.2.2023 in three phases. Initial data collection between 20.12.2022 and 16.1.2023, followed by data validation phase and extended data collection from 16.1.2023 to 1.2.2023, and further validation of the data until 27.2.2022. Gartner contacted, on behalf of Norwegian Directorate of e-Health, a total of 35 vendors. Six of the vendors were currently not present in Norway. The response rate for the survey was 66%, comprising primarily of vendors currently present in Norway and additional vendors not currently present in Norway. Of those vendors currently present in Norway, 70% provided data for this report. Hence, the responses are perceived to showcase a good representation of the Norwegian market.

1.2.   Inclusions and exclusions of the report

This report aims to give an updated view of the EHR vendors currently present in Norway and potential EHR vendors who could enter the market in the future with offerings that fit many of the characteristics of the market.

When selecting an ICT-solution, organizations must decide whether there is a solution in the market that can be used, or whether a suitable solution should be developed specifically for the needs of the organization. This report excludes the option of a bespoke solution; the prerequisite for including vendors and their respective products into this market analysis is that the vendor offers a solution or a partial solution (such as a platform) that will meet customer requirements.

The vendors that were invited to take part in this market analysis were selected on the following criteria:

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1) The vendor is registered in Norway as a provider of patient record or EHR solutions.

2) If not currently present in Norway, the vendor is likely to have an interest in entering the Norwegian market within the near future.

1.3. Delimitations of the report

The report is based on data collection and assessments of the vendor's responses to the market survey. The survey data has been complemented with additional vendor interviews, published Gartner Research and public information where applicable. Because the data collection only includes the vendor perspective, it is important to acknowledge that this report does not reflect potential findings from a user perspective. Please refer to *Chapter 5. Limitations and areas for further analysis* for elaboration on this point.

The raw data collected through the survey is confidential. Only the aggregated result of the analysis is presented in this report. These responses are used to provide the data shown in *Chapter 2. Overview of the current Norwegian EHR market.* To protect the anonymity of individual vendor's responses, the graphs shown include answers from both vendors that are present in Norway and vendors aiming to enter the Norwegian market. When responses are shown in relation to the revenue in the Norwegian market, only the revenue generated from EHR solutions within Norway is made visible.

Please refer to *Chapter 10. References* in the appendix for a complete list of Gartner Research source articles used in this report.

Gartner has not manipulated the data provided by vendors. Where unclear, Gartner have sought to verify with each respondent the understanding and accuracy of the data. The report has been conducted within a set time period. It was not possible to validate the provided data through observing vendors activities over a longer time period or conduct a time series analysis. This limits the reliability of the analysis due to the reliance on answers provided from the vendors and there is therefore a possibility that the underlying data may involve inaccuracies. In addition, some vendors decided not to disclose specific elements of information. Where required for the purposes of providing a holistic picture of the market, Gartner has used estimates to complement the information provided.

1.4. EHR Definition

In this market analysis, the Directorate of E-health has defined EHR based on the cf. Section 4 of the Patient Records Regulation in Norway: *An electronic health record (EHR) refers to an electronic documentation system that provides the most "clear and comprehensive presentation of the patient's health condition".* Hence, an electronic health record (EHR) is an integrated clinical information system that contains patient-centric, electronically maintained information about an individual's health status and care, focuses on tasks and events directly related to patient care, and is optimized for use by clinicians. The EHR provides support for all activities and processes involved in the delivery of clinical care within a single health delivery organization. In this report, the electronic patient record (EPR), electronic medical record (EMR) and patient record are used as synonymous terms for EHR.

Gartner's definition of EHR is similar: *"The EHR is a foundational capability that must connect to a richer ecosystem of modern digital health applications, systems, services, and devices necessary for high-quality, affordable, and patient-centric care. The EHR alone is not sufficient to meet the demands of mass digitization and personalization of care*". (G00742367, December 2021)

An "enterprise EHR" provides functionality for all care settings operated by a healthcare provider, including specialty areas and associated patient administration functions. It minimally provides functionality for acute care settings, such as the medical/surgical wards, emergency

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departments, intensive care units (ICUs), operating theaters and attached clinics, and outpatient and ambulatory settings of the hospital.

2.   Overview of the current Norwegian EHR market

The Norwegian EHR landscape shares similarities with the Nordics and most European countries, where the health delivery organizations have sought the best solution to fit their needs. In response to the increasing demand for interoperability, the healthcare market is transitioning towards a platform-based ecosystem. This model involves various solutions that can exchange data between interconnected systems, as well as allowing third-party vendors to develop or integrate complementary components (Ellingsen, June 2022). Region Midt-Norge stands out as they are in the process of implementing one integrated solution for both primary and specialist healthcare providers. This integrated approach is not currently seen in other regions.

This chapter will examine the current state of the Norwegian EHR market from multiple angles:

- User groups of EHR solutions

- Classification of EHR vendors

- Size of the EHR market

- Characteristics of the EHR solutions available

- Vendor approaches to service delivery

- Vendor approaches to innovation and R&D

- Current and future plans of EHR vendors

2.1.   EHR solution user segments in Norway

Community care services to citizens are provided by Norwegian municipalities at local community level. These services include public healthcare provisioning, nursing homes and homecare services. General practitioners (GPs) working in community care are typically employed under a contract with the municipality. Specialized treatment is offered by hospitals that are governed by the state through four regional health authorities (Helse Nord, Helse Midt-Norge, Helse Vest and Helse Sør-Øst) (Ellingsen, June 2022). In addition to public health care, there also are private health care services, such as occupational health providers, dental care and private hospitals.

The EHR systems used by healthcare organizations are used by multiple healthcare professionals, including nurses, occupational therapists, psychologists primary care physicians, and physiotherapists. These healthcare services and user groups are, in this report, classified into specialized care and primary care, as shown in Table 1.

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Table 1. Health services using EHR solutions in Norway.

Type	Name	Name in Norwegian
Specialized care	Ambulance and patient transport services	*Ambulansetjeneste*
	Hospitals, public and privately funded	*Sykehustjenester, offentlige og private*
	Multidisciplinary specialized healthcare for drug addiction	*Tverrfaglig spesialisert rusbehandling*
	Specialists (physicians) working as private practitioners	*Avtalespesialister*
Primary care	Community acute care inpatient center	*Øyeblikkelig hjelp døgnplasser, ØHD/KAD/KØH*
	Community acute care service and call center	*Legevakt og legevaktsentral*
	Community care center for maternal health and healthcare for children and adolescents	*Helsestasjon inkl. skolehelsetjeneste*
	Community Care Systems (including institution-based care, home-based care and care service management)	*Pleie- og omsorgssystemer (PLO-systemer)*
	Dental health services, private and public	*Tannlegetjeneste, privat og fylkeskommunal*
	General practitioners, publicly or privately funded	*Fastlegetjeneste, inkludert evt. private allmennleger*
	Occupational health services	*Bedriftshelsetjeneste*
	Physiotherapist and others in physical medicine working in private practice	*Privatpraktiserende fysio-terapeuter m.m, med eller uten avtale*
	Psychologists working as private practitioners	*Privatpraktiserende psykologer med eller uten avtale*

The EHR solutions evaluated in this report serve various use cases, including inpatient care, outpatient care, home-based care, and specialized use cases. To ensure vendor confidentiality and encourage participation in the study, the solutions were grouped according to their primary use case focus, as shown in Table 2. The approach taken in this report aims to balance a detailed evaluation of the market with maintaining anonymity of individual vendors. This categorization, however, may overlook some capabilities that are relevant to specific use cases.

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Table 2. Type of the use cases in the case of each health service

Use case	Detailed use case	User groups
Outpatient focus	Outpatient	Community care center for maternal health and healthcare for children and adolescents
		General practitioners, publicly or privately funded
		Physiotherapists and others in physical medicine working in private practice
		Psychologists working as private practitioners
		Specialists (physicians) working as private practitioners
		Occupational health services
		Dental health services, private and public
		Community care center for maternal health and healthcare for children and adolescents
Mix of inpatient and outpatient focus	Outpatients and home-based	Community acute care service and call center
	Inpatients	Multidisciplinary specialized healthcare for drug addiction
		Community Acute Care Inpatient Center
	Inpatients and home-based	Community Care Systems
	Inpatients, outpatients (and home-based)	Hospitals, public and privately funded
	Specialized	Ambulance and patient transport services

2.2. Vendor type and geographic footprint

The segmentation used in this report classifies Norwegian EHR market players into three categories. As shown in
Table 3, the EHR vendors active in the Norwegian market vary in size, scale, and market approach.

Table 3. EHR vendor categorization by vendor type and geographic footprint

| EHR Vendor Segment	Description of the vendor segment	Customer focus
Global megasuite vendors and European EHR vendors	*US-based large scale EHR vendors* who have a wide global reach and range of functional capabilities offered. *European EHR vendors* based in the EMEA region or in the Nordics and with a geographic foothold focusing on EMEA or specifically in the Nordics. Some of the vendors in this category do specialize in EHR products, some serve a wider range of industry verticals in addition to healthcare.	Specialized care or a combination of specialized and primary care.
Norwegian EHR vendors	*Norwegian EHR vendors* headquartered in Norway, offering a wide range of solutions. This segment includes modern SaaS startups, web-based vendors,	Community care and community acute care, hospitals, specialized

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EHR Vendor Segment	Description of the vendor segment	Customer focus
	and vendors of traditional EHR solutions. Some vendors in this place are replacing their old EHR product with a SaaS solution.	practices; private and public care.
Norwegian specialist EHR vendors	*Norway-based specialist providers* for a specialty area such as dental practices, physiotherapists and psychologists.	Small to medium practices, public and private care.

2.3. Size of the Norwegian EHR market

For this report, EHR solution vendors were asked to state their annual revenue from EHR products from 2020 to 2022 in Norway. The size of the Norwegian EHR market presented in this report is based on these vendor responses. It is possible that some vendors have included services, such as consulting services' revenue, closely connected with their EHR solution, whereas some other vendors may have included only the revenue generated directly by their application services. Out of the respondents active in the Norwegian market, 60% provided information on their EHR solution revenue in Norway, whereas 40% of vendors either did not provide revenue information or did not participate in this survey at all. For those vendors who decided not to disclose the information about their EHR revenue from the Norwegian market, Gartner has estimated the respective revenue based on publicly available information.

The total EHR market is estimated to be approximately 1.742 MNOK in 2022, with a compound annual growth rate (CAGR) of +18% between 2020 and 2022. In comparison, the market size for the EHR market in Norway in 2014 with the participating vendors (7 participants) was at 551 MNOK (adjusted for inflation, 551 MNOK in 2014 is 714 MNOK in 2023). The growth in market size is can likely be explained by the extended scope of vendors in this survey, and the high activity level in the EHR market after the pandemic as the nature of healthcare has become more IT-intensive. Figure 1 shows the overview of the Norwegian EHR market size.

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Figure 1. Overview of the Norwegian EHR market size based on revenue generated by EHR solutions.[1]
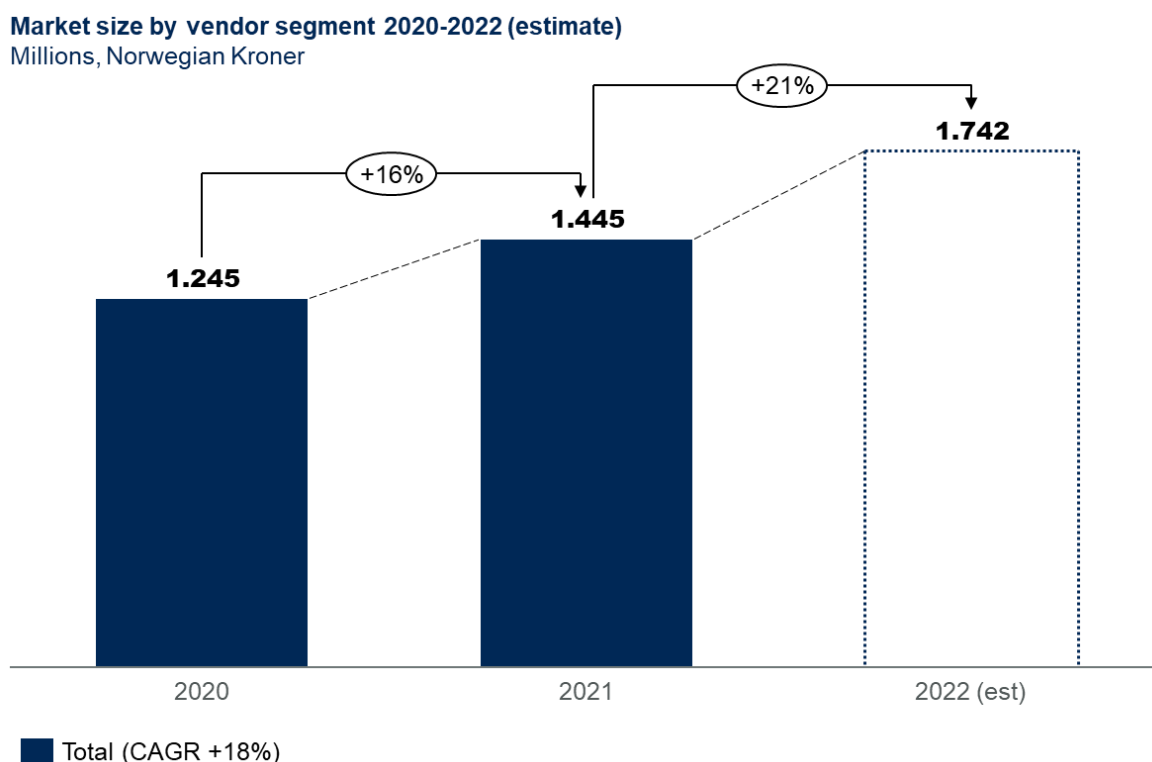
Market size by vendor segment 2020-2022 (estimate)
Millions, Norwegian Kroner

Total (CAGR +18%)

In comparison, the market size for the EHR market in Norway in 2014 with the participating vendors (7 participants) was at 551 MNOK (adjusted for inflation, 551 MNOK in 2014 is 714 MNOK in 2023). The growth in market size is can likely be explained by the extended scope of vendors in this survey, and the high activity level in the EHR market after the pandemic as the nature of healthcare has become more IT-intensive.

In the subsequent chapters, this report discusses how the market is split by vendor's user segment focus and vendor's type of geographic footprint. It is important to acknowledge that the definition of "EHR solution" used in this report is relatively wide, so some of the vendors included in the total market are solution providers for a niche market segment.

### 2.3.1. Market share by vendor user segment focus

The split of the market by the vendors' focus on serving specific user groups is shown in Figure 2. In 2021, the largest share of the market (35%) was held by vendors focusing on both primary and specialized care serving a mix of inpatient and outpatient use cases. The second largest group were vendors focusing on both primary and specialized care, but only outpatient use cases (22%). Vendors focusing on primary care only contributed a total of 34% (outpatient focus 13% and a mix of inpatient and outpatient focus 21%). The remaining section of the market was served by vendors not categorized within this report, representing 11% of the market.

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[1] *Includes patient record vendors present in the Norwegian and registered as patient record providers with Directorate of E-health. The market size is based on EHR solution driven revenue from Norway and on vendor provided information for 60% of the vendors and based on revenue available from the publicly available sources for 40% of the vendors. For vendors with information only available between 2020 and 2021, Gartner has extrapolated the revenue development to estimate the 2022 figures. Vendor revenue for those vendors serving multiple user groups via multiple products have been split primarily by the proportion of number of users served of if not available, by the proportion of number organizations served.*

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Figure 2. Market Size by Vendor's type and geographic footprint, excluding vendors not currently active in the Norwegian market[1]

Market size by vendor user segment focus 2020-2022 (estimate)
Millions, Norwegian Kroner
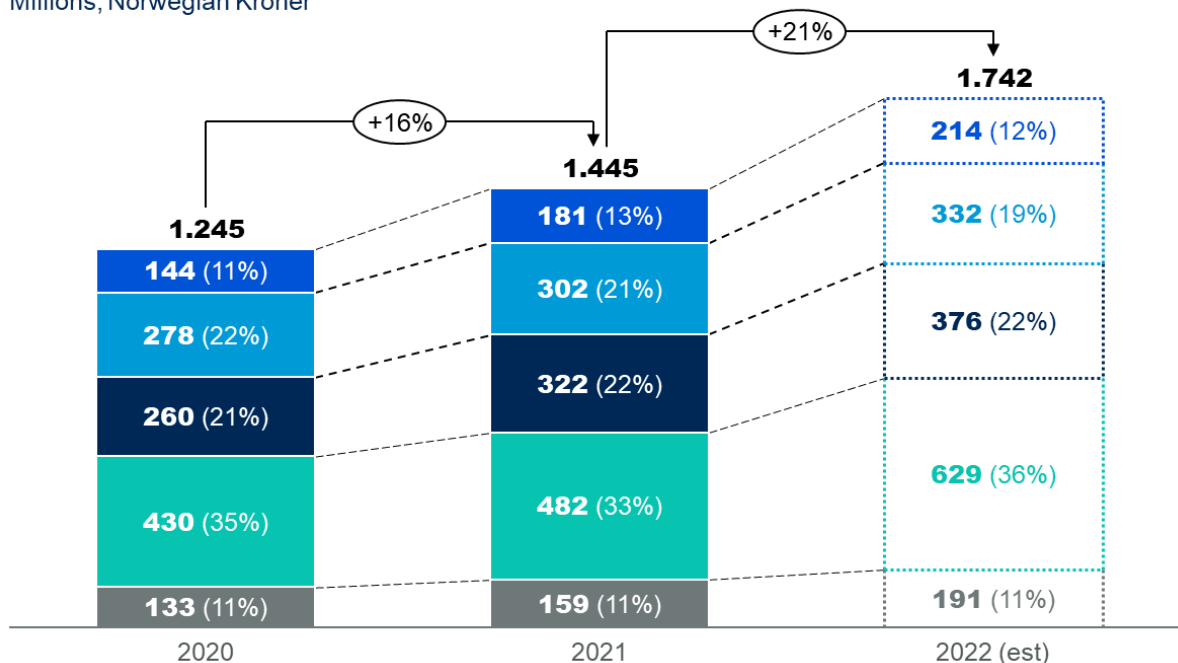
Legend:
- ■ Primary care, outpatient focus (CAGR +22%)
- ■ Primary care, mix of inpatient and outpatient focus (CAGR +9%)
- ■ Primary and specialized care, outpatient focus (CAGR +20%)
- ■ Primary and specialized care, mix of inpatient and outpatient focus (CAGR +21%)
- ■ n/a (CAGR +20%)

As shown on the compound annual growth rates, the market share of the vendors serving primary care and outpatient use cases only grew the most: on average at the rate of 22% between 2020 and 2022. Vendors focusing on primary and specialized care and in both inpatient and outpatient use cases grew at the rate of 21%, followed by vendors serving primary and specialized care but having only outpatient focus at 20%. Those vendors focusing on primary care and a mix of inpatient and outpatient use cases grew at 9%. The group marked as "n/a" demonstrated growth of 20% during this period.

2.3.2. Market share by vendor type and geographic footprint

The Norwegian EHR market has been traditionally characterized by certain EHR vendors having a strong foothold. However, based on the vendor responses, the market dynamics are changing with new vendors, including international EHR solution providers and Norwegian emerging SaaS-based providers gaining increasing foothold. (Gartner, September 2014)

The split of the market, as shown in Figure 3, indicates that the Norwegian EHR vendors in 2021 held strong presence in the market with a total of 60% of the market share, and when

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[2] *Includes patient record vendors present in the Norwegian and registered as patient record providers with Directorate of E-health. The market size is based on EHR solution driven revenue from Norway and on vendor provided information for 60% of the vendors and based on revenue available from the publicly available sources for 40% of the vendors. For vendors with information only available between 2020 and 2021, Gartner has extrapolated the revenue development to estimate the 2022 figures. Vendor revenue for those vendors serving multiple user groups via multiple products have been split primarily by the proportion of number of users served of if not available, by the proportion of number organizations served.*

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combined with the Norwegian Specialists EHR vendors, a total of 72% of the market share. Global megasuite EHRs and some European EHR vendors held 28% of the market share.

Figure 3. Market Size by Vendor's type and geographic footprint, excluding vendors not currently active in the Norwegian market[1]

Market size by vendor type and geographic footprint 2020-2022 (estimate)
Millions, Norwegian Kroner
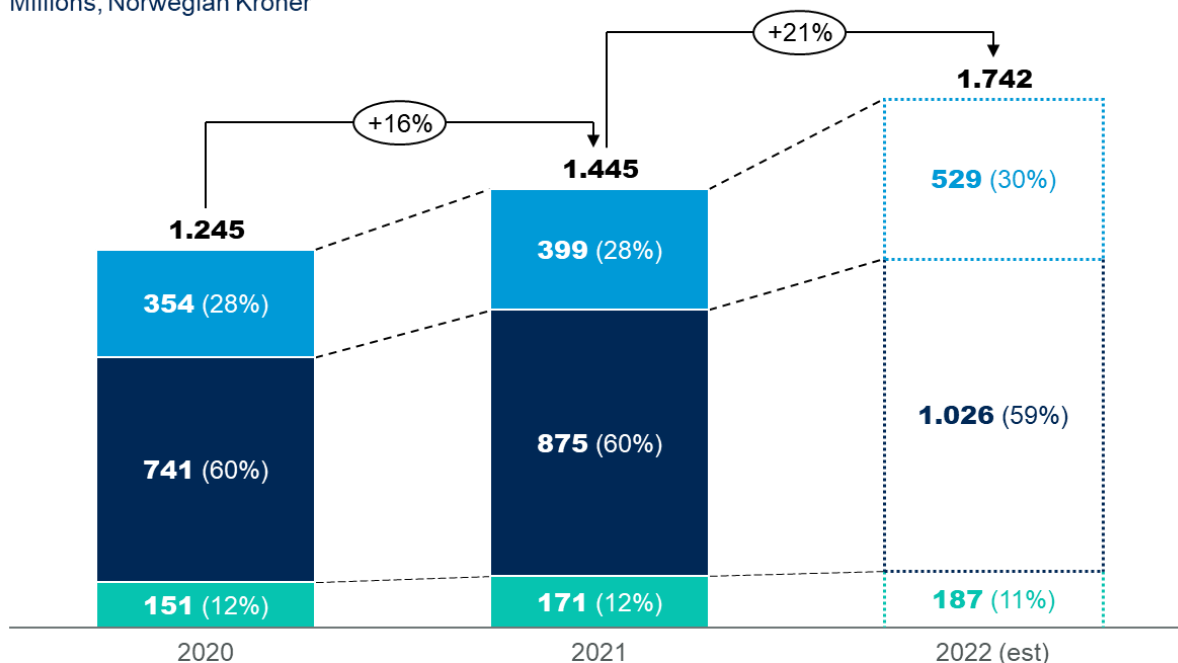
- Global mega suite and European EHR vendors (CAGR +22%)
- Norwegian EHR Vendors (CAGR +18%)
- Norwegian Specialist EHR Vendors (CAGR +11%)

The split of the market by vendor type and geographic footprint shows that all vendor categories were growing. The fastest compound annual growth rate in market share between 2020 and 2022 has been in the Global megasuites and European EHR vendors category (22%), followed by the Norwegian EHR vendors (18%). The Norwegian specialist EHR vendors had slightly slower growth of 11%.

2.4.   Characteristics of the EHR solutions

Globally, enterprise EHR vendors have developed product portfolios to keep pace with business demands in core areas of clinical EHR systems that cover the clinical documentation needs across a full spectrum of care, including specialty areas. For these vendors, other development areas include order management; communication; clinical decision support; patient administration; security, identity and access management; integration and interoperability as well as reporting and analytics.

In Norway, the extent to which vendors offer solutions supporting different capabilities vary.

This report's analysis of capabilities of EHR solutions is based on Gartner's extensive experience and knowledge in the field. This knowledge is derived from various sources,

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[1] *Includes patient record vendors present in the Norwegian and registered as patient record providers with Directorate of E-health. The market size is based on EHR solution driven revenue from Norway and on vendor provided information for 60% of the vendors and based on revenue available from the publicly available sources for 40% of the vendors. For vendors with information only available between 2020 and 2021, Gartner has extrapolated the revenue development to estimate the 2022 figures. Vendor revenue for those vendors serving multiple user groups via multiple products have been split primarily by the proportion of number of users served of if not available, by the proportion of number organizations served.*

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including a database of EHR solution data, previous engagements with clients in the healthcare industry (as well as other industries), and insights gained from interviews with industry experts and analysts.

To evaluate relevant capabilities of EHR vendors, multiple sources were consulted, including interviews with vendors, subject matter experts, and analysts. In addition, vendor-provided materials were analyzed, and Gartner's database of EHR solution data was utilized. Through this approach, an assessment of the EHR vendor landscape was obtained as well as a list of capabilities to evaluate.

The capabilities discussed in this report are grouped into fundamental and additional capabilities as follows (for a detailed list of capabilities and their definitions, please see *Appendix 9.2. Definitions of EHR system capabilities*):

- Fundamental capabilities

- Additional capabilities

This section discusses how well EHR solutions provide support for these capabilities and to what extent these user segments are covered from the capability perspective. In addition, this section discusses the integration capabilities offered by the EHR solutions, architectural types used as well as solutions' compliance with the Norwegian compulsory and recommended standards and with other international standards.

2.4.1. Observed fundamental capabilities offered by EHR solutions

Overall, the EHR solutions present in the Norwegian market do offer wide support for fundamental capabilities as described by the vendors. Fundamental capabilities refer to the capabilities an EHR solution would typically be expected to have in most of the use cases (for a detailed list of capabilities and their definitions, please see *Appendix 9.2. Definitions of EHR system capabilities).* These capabilities are as follows:

- *Clinical documentation and data capture* refers to the ability of an EHR to capture a wide range of patient data including medical history, medication lists, allergies, lab results, and vital signs.

- *Clinical workflow (basic)* refers to the ability of the EHR to support the basic processes involved in clinical care and manage the information needed for those. (For example, document signing, transcription, support for diagnostic processes, basic process management etc.)

- *Data model* refers to the ability of an EHR to access a flexible permanent data store including database design, uniform file system and flexible data structures, audit trails and formal database management system with metadata.

- *EHR system management, privacy and access management* refer to a rich set of functionality and services that are focused on making the overall system easier to understand, configure, provision, maintain, and monitor. For example, role based access.

- *Integration and interoperability* refer to the ability of an EHR to communicate and interact with other systems in the EHR environment, for example, enable two-way exchange of coded data between EHR and other applications and medical devices.

- *Order management* refers to the ability of an EHR to include direct entry of both medication and non-medication orders (for example, referrals and consult requests, lab tests or imaging studies).
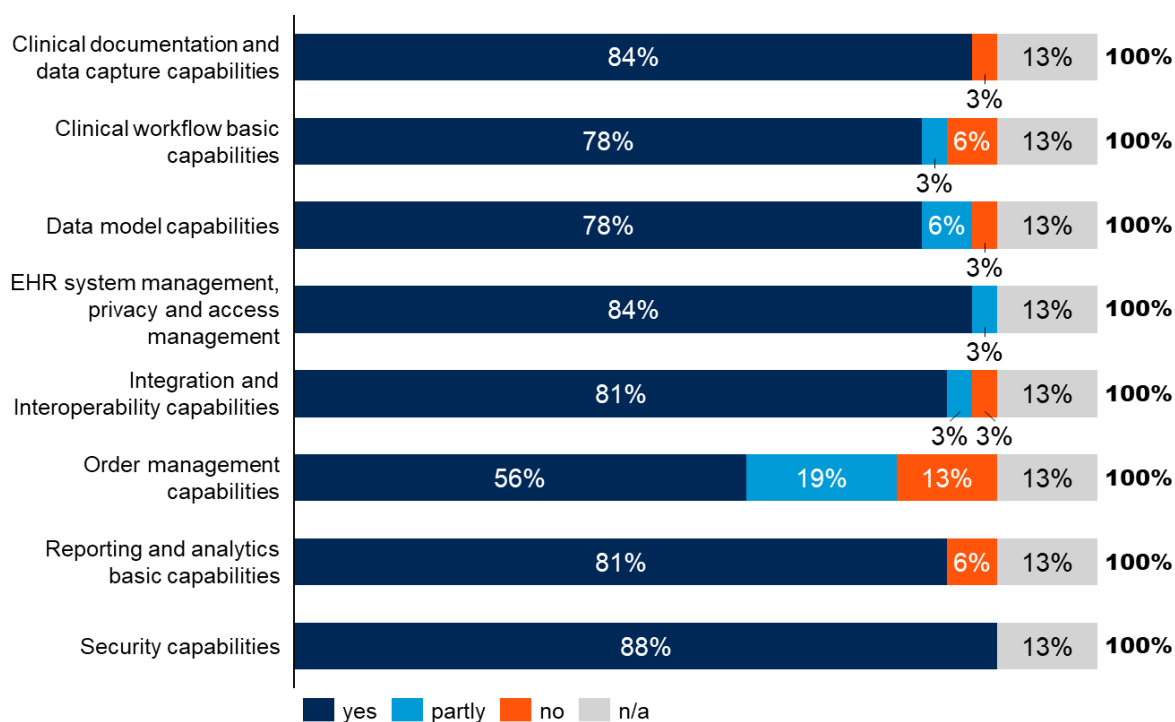
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- *Reporting and analytics basic* refer to the ability of an EHR to support operational and clinical reporting such as simple standard reports and the ability to export data from any module into a centralized data repository for reuse.

- *Security* refers to the ability of an EHR to have robust security and privacy protections to safeguard patient data. For example, measures to prevent unauthorized access to patient data; ensure that data is only shared with authorized users; ensure that clinical data is only visible for the responsible clinician; and cybersecurity capabilities.

The vendors were asked to select, for each of their EHR solutions offered, whether the solution supports the given capability fully or partially and, where applicable, to elaborate on their answer. Almost all EHR solutions supported these foundational capabilities. As shown in Figure 4, the exception here are the order management capabilities for which some products offer only partial support or no support at all. Out of the responding vendors, 13% opted not to answer this question.

Figure 4. Overview of EHR solutions with support for foundational capabilities, including products not currently present in the Norwegian market

Does your EHR system have the following capabilities?
Percentage the EHR solutions (%), n=32

| Capability	yes	partly	no	n/a	Total
Clinical documentation and data capture capabilities	84%		3%	13%	100%
Clinical workflow basic capabilities	78%	3%	6%	13%	100%
Data model capabilities	78%	6%	3%	13%	100%
EHR system management, privacy and access management	84%	3%		13%	100%
Integration and Interoperability capabilities	81%	3%	3%	13%	100%
Order management capabilities	56%	19%	13%	13%	100%
Reporting and analytics basic capabilities	81%		6%	13%	100%
Security capabilities	88%			13%	100%

yes ■ partly ■ no ■ n/a

Percentages may not add up to 100% because of rounding.

Using revenue as a measure for market share for each EHR solution (Figure 5) shows what proportion of the total market supports, partly supports or does not support each of the fundamental capabilities. From this, it can be seen that fundamental capabilities are widely covered by EHR solutions in use in the market. The majority of the market (86% by revenue) consists of products that support all capabilities in this group. Those products that where information was not disclosed about the support for capabilities have a negligible role in the Norwegian market.

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Figure 5. Combined EHR solution revenue by supported fundamental capabilities, excluding products not currently present in the Norwegian market

Does your EHR system have the following capabilities?
Percentage the EHR solution revenue in Norway (%), n=30
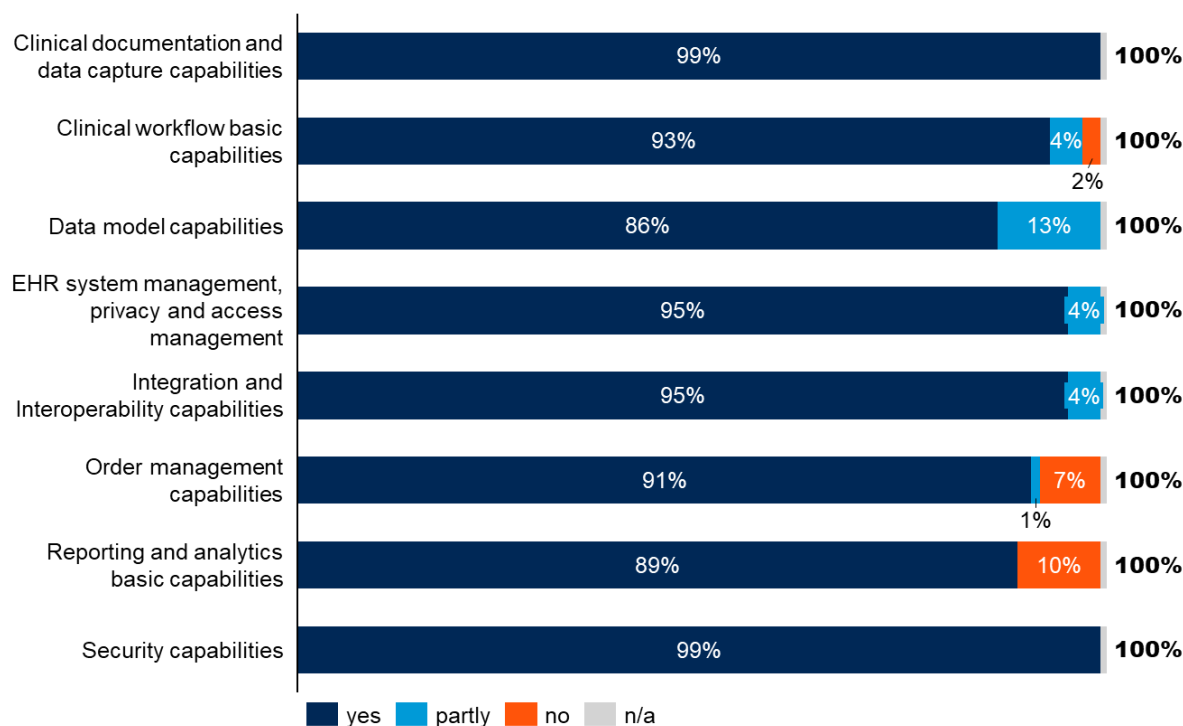
Percentages may not add up to 100% because of rounding.

## 2.4.2. Observed additional capabilities offered by EHR solutions

As with the fundamental capabilities, a set of additional capabilities was identified and shared with vendors to identify what functionality each EHR solution provides. For a detailed list of capabilities and their definitions, please see *Appendix 9.2. Definitions of EHR system capabilities.* These additional capabilities refer to other capabilities an EHR system might have, typically for a set of specific use cases the EHR might be designed for. These additional capabilities are as follows:

- *Care coordination* refers to the ability of an EHR to securely share patient information between multiple parties giving care.

- *Clinical decision support (CDS) and rule-based CDS* refers to the ability of an EHR system to provide clinical decision support tools to help healthcare providers make informed treatment decisions and diagnostics. Rules-based CDS allows users to incorporate rules and decisions to support the clinical care processes in a more sophisticated way.

- *Advanced clinical decision support, based on AI and ML* refers to the ability of the EHR systems to provide advanced clinical decision support tools utilizing technologies such as AI (artificial intelligence), ML (machine learning) and NLP (natural language processing).

- *Clinical display/dashboard* refers to the ability of an EHR to present captured data (including clinical and patient data) in a meaningful manner that contributes to the clinician's ability to use the data effectively. Configurability is essential.

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- *Clinician experience* refers to the ability of an EHR's ability to support clinical experience, for example: mobility, personalization, user analytics, system education, speech recognition / digital transcription and clinical communication and collaboration.

- *Clinical workflow (advanced)* refers to the ability of an EHR's ability to support additional workflows involved in clinical care and manage the information needed.

- *Clinical research and* real-world evidence (*RWE)* refer to the ability of an EHR to support research and knowledge creation. For example, RWE that derives insights from real-world data (RWD); clinical trials and clinical registries.

- *Patient administration* refers to scheduling; registration; admission, discharge and transfer (ADT); and bed management. These modules are often collectively referred to as Patient Administration Systems (PASs) in Norway.

- *Patient engagement* refers to the ability of an EHR to engage and directly interact with a patient. Some of these capabilities may be provided by Helsenorge.

- *Reporting and analytics advanced* refers to the ability of an EHR to support advanced reporting and analytics needs, such as population health management, reporting support and combining data from multiple data sources.

- *Telemedicine / Virtual care* refers to the ability of an EHR to support the planning of telemedicine, either by providing telemedicine tools, provisioning telemedicine tools via ancillary solution or integrability to telemedicine solutions.

- *Clinical specialty* refers to the ability of an EHR to support clinical specialty areas.

Support for additional capabilities is widely covered, but there are significant differences across the capability areas. As shown in Figure 6, most of the EHRs (75%) provide support for patient administration capabilities fully with an additional 9% partially. In addition, care coordination capabilities are also widely supported (72% fully and an additional 3% partially) as well as clinician experience capabilities (66% fully and additional 9% partially). Advanced clinical decision support capabilities have surprisingly low support (only 19% fully and additional 6% partially). Other capabilities with the least support from the EHR solutions are clinical research and RWE capabilities (supported by 34% of the solutions fully and additional 9% partially) and advanced clinical workflow capabilities (supported by 38% of the solutions fully and additional 22% partially).
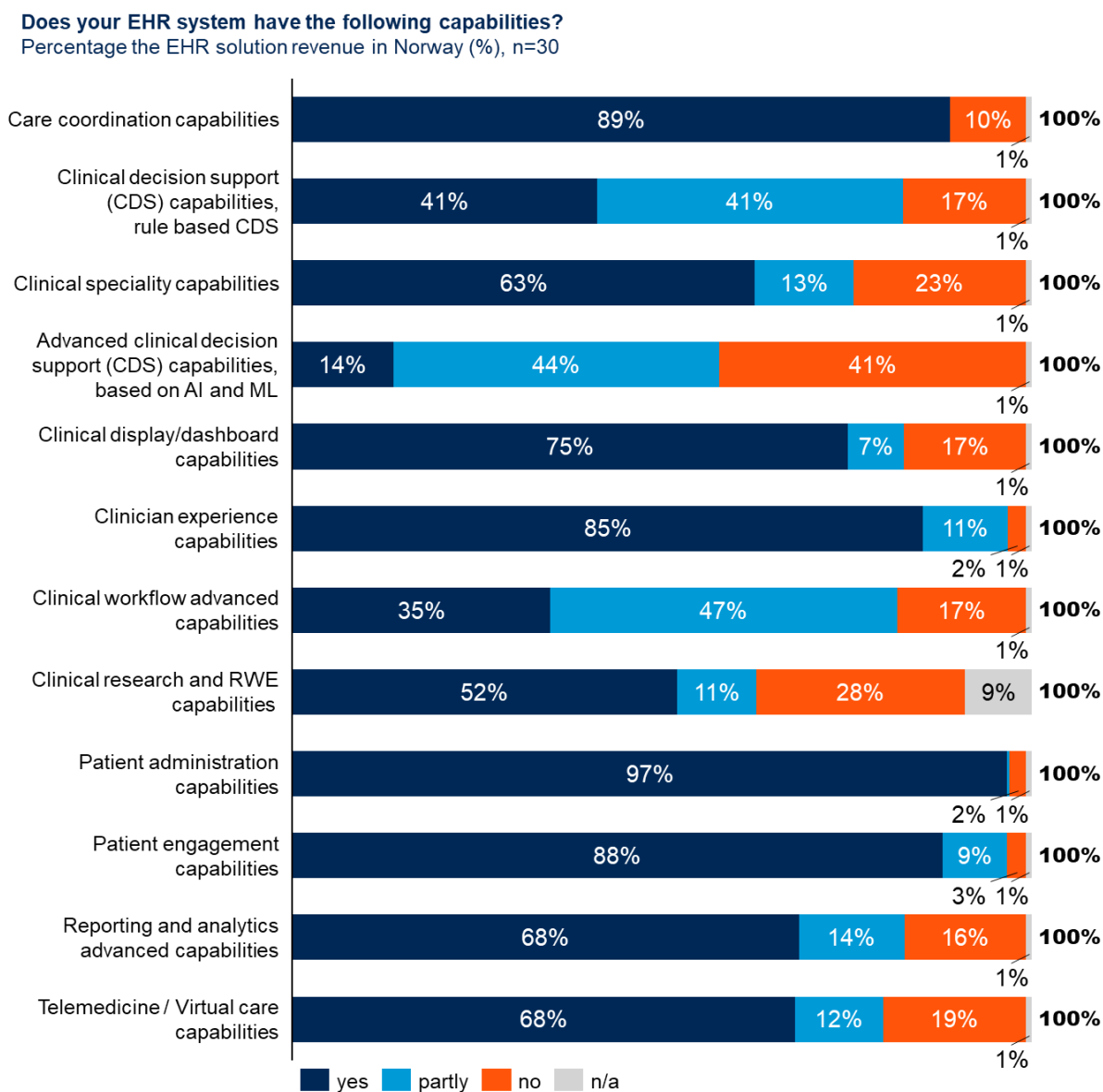
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Figure 6. Overview of EHR solutions with support for additional capabilities, including products not currently present in the Norwegian market

Does your EHR system have the following capabilities?
Percentage the EHR solutions (%), n=32
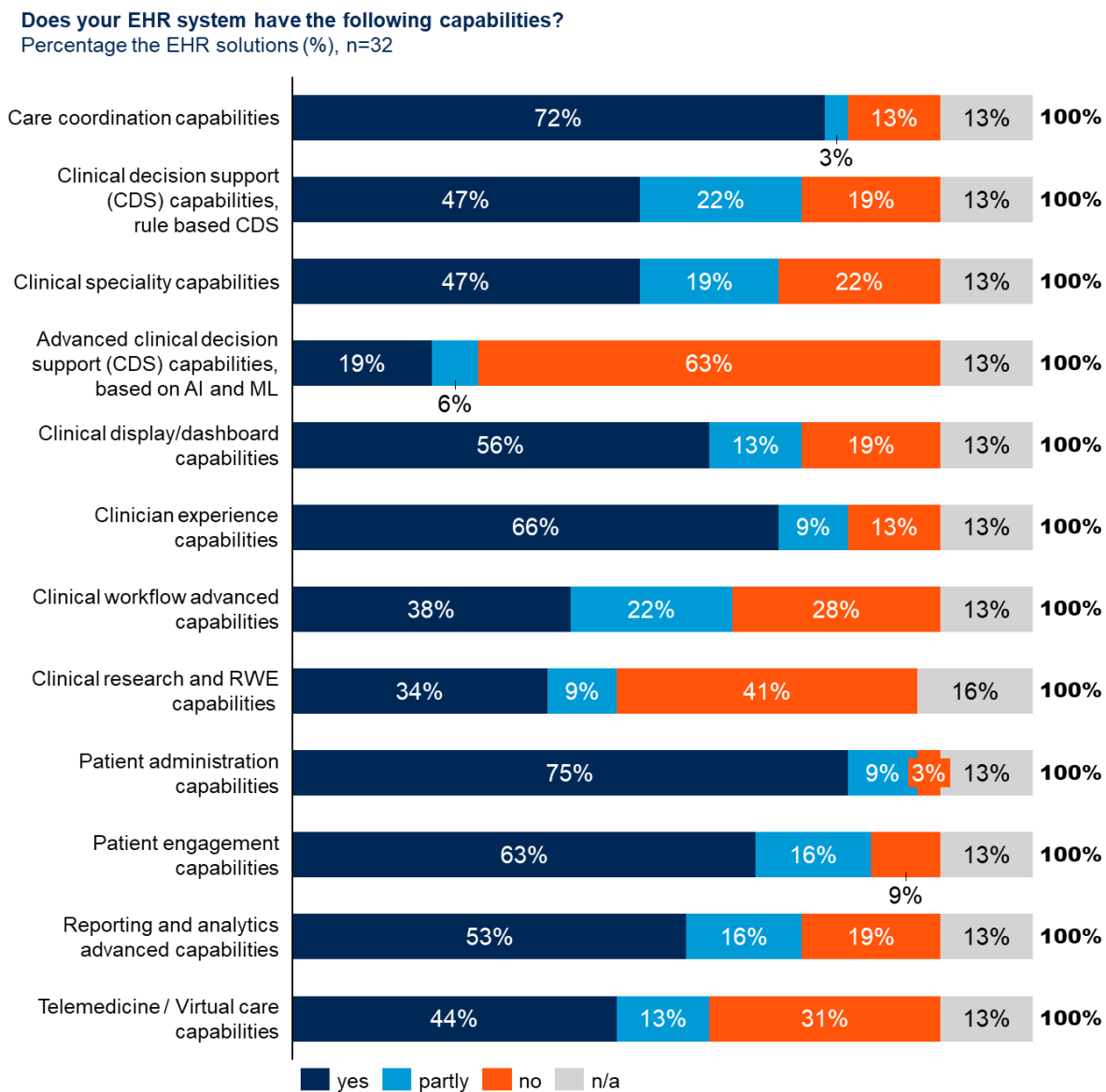
Percentages may not add up to 100% because of rounding.

Again, using revenue as a measure for market share for each EHR solution, Figure 7 shows the proportion of the total market that supports, partly supports or does not support each of the additional capabilities. The most widely supported capabilities were patient administration capabilities (97% of revenue generated by solutions supporting this capability fully), care coordination capabilities (89% of revenue generated by solutions supporting) and patient engagement capabilities (88% of the revenue generated by solutions supporting this capability fully and an additional 9% partially). The least supported additional capabilities were advanced clinical decision support (only 14% of market share hold by solutions supporting this capability fully although an additional 44% partially), advanced clinical workflow capabilities (35% of revenue generated by solutions supporting this capability fully and an additional 47% partially), and clinical decision support capabilities that are rule based (41% of the revenue being generated by solutions supporting this capability fully and an additional 41% partially).

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Figure 7. Combined EHR solution revenue by supported additional capabilities, excluding products not currently present in the Norwegian market

Does your EHR system have the following capabilities?
Percentage the EHR solution revenue in Norway (%), n=30

Capability	yes	partly	no	n/a
Care coordination capabilities	89%		10%	1%
Clinical decision support (CDS) capabilities, rule based CDS	41%	41%	17%	1%
Clinical speciality capabilities	63%	13%	23%	1%
Advanced clinical decision support (CDS) capabilities, based on AI and ML	14%	44%	41%	1%
Clinical display/dashboard capabilities	75%	7%	17%	1%
Clinician experience capabilities	85%	11%	2%	1%
Clinical workflow advanced capabilities	35%	47%	17%	1%
Clinical research and RWE capabilities	52%	11%	28%	9%
Patient administration capabilities	97%		2%	1%
Patient engagement capabilities	88%	9%	3%	1%
Reporting and analytics advanced capabilities	68%	14%	16%	1%
Telemedicine / Virtual care capabilities	68%	12%	19%	1%

Legend: ■ yes ■ partly ■ no ■ n/a

Percentages may not add up to 100% because of rounding.

2.4.3. Observed focus user segments served by the EHR solutions

As discussed in *Chapter 2.1. EHR solution user segments in Norway*, the user segments using EHR products in Norway were categorized into specialized and primary care users. The vendors were asked three questions in relation to their EHR solution:
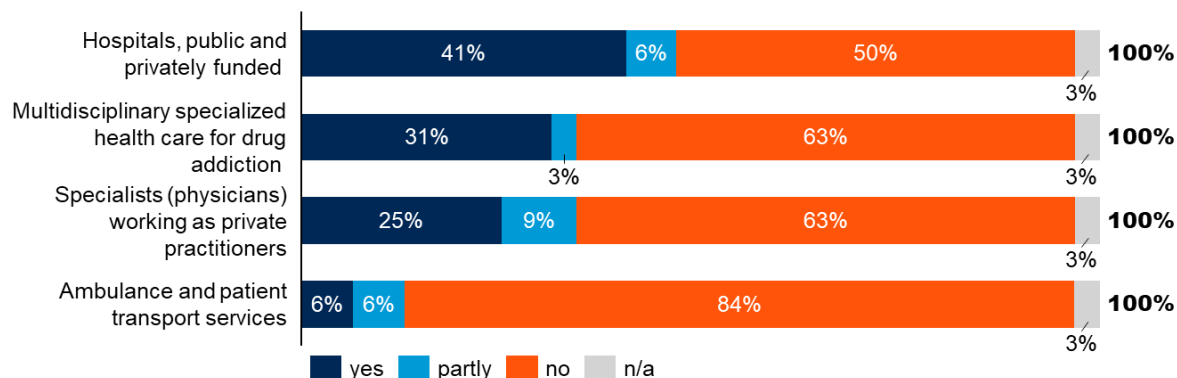
- *Health service areas that are served by the EHR solutions*
- *Size of the (health) delivery organizations each EHR product serves*
- *Type of the (health) delivery organizations each EHR* product serves.

As a rule, the more general EHR solutions serve a wide range of users and use cases. The responses for EHRs serving specialized care user segment are shown in Figure 8 and for EHRs serving primary care user segment in Figure 9. Although an EHR solution can serve

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more than one user group, the vendor responses show that most of the vendors aim the EHR products for serving specific user groups.

Figure 8. Percentage of EHR solutions serving specialized care user groups, including products not currently present in the Norwegian market
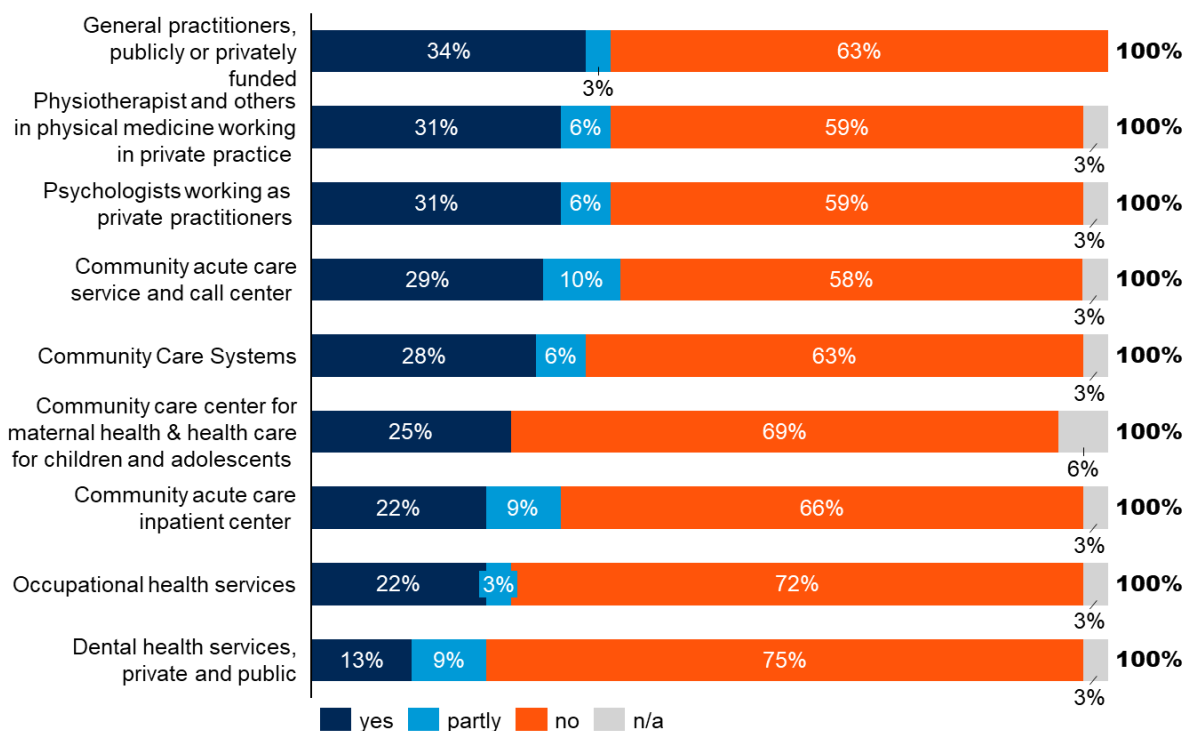
Indicate which of the following health service areas that are served by your EHR solution
Percentage the EHR solutions in Norway (%), n=32

	yes	partly	no	n/a
Hospitals, public and privately funded	41%	6%	50%	3%
Multidisciplinary specialized health care for drug addiction	31%	3%	63%	3%
Specialists (physicians) working as private practitioners	25%	9%	63%	3%
Ambulance and patient transport services	6%	6%	84%	3%

Percentages may not add up to 100% because of rounding.

Figure 9. Percentage of EHR solutions serving primary care user groups, including products not currently present in the Norwegian market

Indicate which of the following health service areas that are served by your EHR solution
Percentage the EHR solutions in Norway (%), n=32

	yes	partly	no	n/a
General practitioners, publicly or privately funded	34%	3%	63%	
Physiotherapist and others in physical medicine working in private practice	31%	6%	59%	3%
Psychologists working as private practitioners	31%	6%	59%	3%
Community acute care service and call center	29%	10%	58%	3%
Community Care Systems	28%	6%	63%	3%
Community care center for maternal health & health care for children and adolescents	25%		69%	6%
Community acute care inpatient center	22%	9%	66%	3%
Occupational health services	22%	3%	72%	3%
Dental health services, private and public	13%	9%	75%	3%

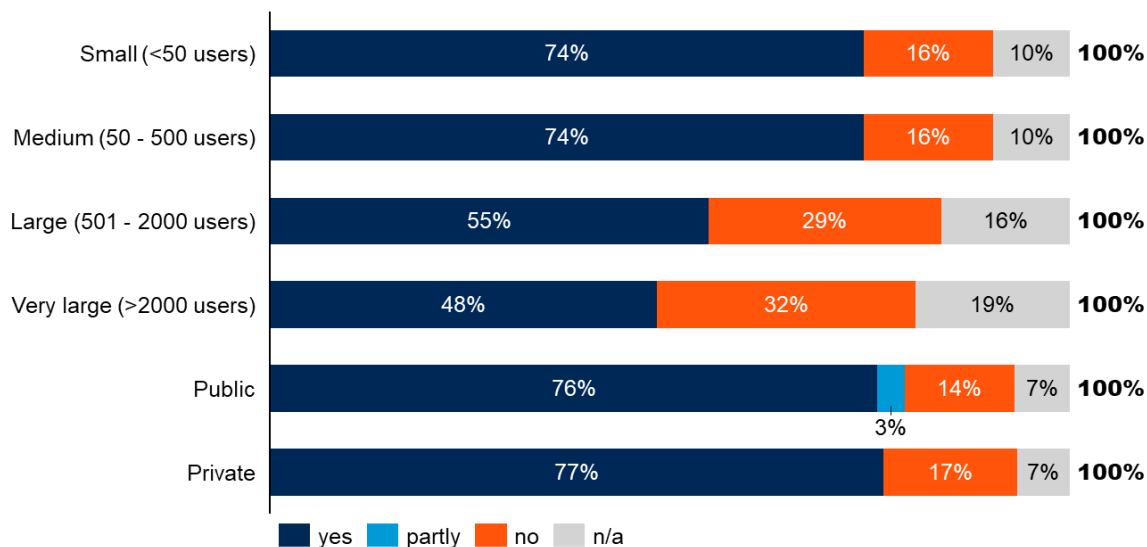Percentages may not add up to 100% because of rounding.

EHRs covered in this report serve a range of users from small to very large health delivery units in both the public and private sector. However, fewer solutions are targeted at large and very large organizations than smaller and medium sized ones. Figure 10, which shows the responses categorized by the size and type of the organizations served, suggests that the

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majority of EHR products are designed to serve small or medium-sized organizations, with large and very large organizations being the minority. Furthermore, EHR solutions were stated to be quite even in terms of their perceived suitability towards public or private organizations.

Figure 10. Size and type of the organizations served by EHR solutions, including products not currently present in the Norwegian market

Indicate what size and type of the delivery organizations do you serve by your EHR solution
Percentage the EHR solutions in Norway (%), n=32

Percentages may not add up to 100% because of rounding.

2.4.4. Observed capability and user segment coverage

Based on vendor responses, it is possible to further analyze how widely certain capabilities are supported by solutions focused for that user group. As discussed in *Chapter 2.4.1. Observed fundamental capabilities offered by EHR solutions*, fundamental capabilities are covered by most of the EHR solutions, with the exception of Order management capabilities. Moreover, in *Chapter 2.4.2. Observed additional capabilities offered by EHR solutions*, the responses indicated varying levels of support for additional capabilities across all user groups.

To identify whether there are certain user groups that are underserved, the vendor responses on which capabilities their EHR product supported were further analyzed across the user groups those products served. This analysis, based on the vendor responses, is presented in Figure 11.

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Figure 11. Summary of user groups and the capabilities supported by EHR solutions, including products not currently present in the Norwegian market[4]

User group (number of products)	Fundamental								Additional											
	Clinical documentation and data capture	Clinical workflow basic	Data model	EHR system management, privacy and access	Integration and Interoperability	Order management	Reporting and analytics basic	Security	Care coordination	Clinical decision support (CDS), rule based CDS	Advanced CDS (AI / ML)	Clinical display/dashboard	Clinician experience	Clinical workflow advanced	Clinical research and RWE	Patient administration	Patient engagement	Advanced reporting and analytics	Telemedicine / Virtual care	Clinical specialty
Specialized care																				
Ambulance and patient transport services (4)	100%	75%	100%	100%	100%	63%	100%	100%	100%	88%	38%	100%	75%	50%	100%	63%	75%	63%	63%	75%
Hospitals (15)	100%	93%	97%	100%	100%	80%	100%	100%	90%	77%	23%	83%	83%	57%	53%	87%	80%	67%	57%	77%
Multi-disciplinary specialized health care for drug addiction (11)	91%	91%	86%	91%	91%	82%	91%	91%	91%	64%	27%	68%	86%	64%	45%	86%	82%	73%	55%	59%
Specialists (physicians/ private practitioners) (11)	82%	82%	82%	82%	82%	73%	82%	82%	77%	59%	18%	59%	82%	59%	36%	77%	77%	68%	55%	59%
Primary care																				
Acute care (inpatient center) (10)	100%	95%	95%	95%	95%	95%	100%	100%	100%	80%	50%	90%	95%	70%	60%	95%	95%	80%	75%	60%
Community care systems (11)	100%	95%	95%	95%	95%	86%	100%	100%	100%	64%	45%	73%	95%	73%	68%	95%	86%	91%	73%	59%
Dental health services (6)	83%	83%	83%	100%	83%	67%	100%	100%	83%	83%	17%	75%	75%	75%	42%	92%	100%	75%	42%	75%
Physio-therapists, physical medicine (private practice) (12)	92%	92%	92%	92%	92%	79%	83%	92%	79%	67%	38%	67%	92%	58%	29%	92%	88%	71%	75%	54%
Community care for maternal, children, and adolescents (8)	88%	88%	88%	88%	88%	75%	88%	88%	88%	88%	44%	88%	75%	56%	56%	75%	75%	75%	63%	50%
Acute care (service and call center) (13)	92%	85%	92%	92%	92%	81%	85%	92%	85%	62%	27%	65%	85%	46%	50%	81%	85%	58%	69%	58%
Psychologists (private practice) (12)	92%	92%	92%	92%	92%	79%	75%	92%	71%	58%	29%	58%	92%	50%	21%	92%	88%	63%	75%	46%
General practitioners (11)	82%	82%	82%	82%	82%	77%	73%	82%	68%	45%	23%	55%	82%	45%	27%	82%	77%	55%	68%	59%
Occupational health services (7)	86%	86%	86%	86%	86%	64%	57%	86%	50%	36%	0%	43%	86%	36%	0%	86%	79%	36%	64%	50%

[4] *Calculated based on vendor responses as follows: 100% if the particular solution supports the capability and as 50% if the particular solution partially supports the capability. E.g., 63% of the 4 vendors within the Ambulance and patient transport market cover order management. This means that 2 vendors cover the capability fully (50%), and 1 vendor covers the capability partly. 0.5*25% = 12.5% → 50% + 12.5% = 62.5%*

Most products that target specialized care offer fundamental capabilities - although order management is only available in some of the EHR solutions. Moreover, many capabilities in the additional capabilities group are offered by only a fraction of the EHR solutions, even though those could be valuable additions to improve both patient and clinician experience as well as patient safety and effectiveness of the clinical work.

EHR solutions for community care offer a broader capability coverage for foundational capabilities than for instance products for occupational health and general practitioners. This may seem contrary to user feedback described in previous reports (Direktoratet for e-helse, 2022). This investigation has not performed a mapping of user needs against capabilities (see *Chapter 5. Limitations and areas for further analysis*), and hence can only present information from the vendor side. One possible explanation of these findings could be that the vendors developing products for occupational health and general practitioners have focused on functionality aimed at a specific type of user, while those of community care are developed to meet a broader range of capabilities, prioritizing generic functionalities for several types of users at once. When it comes to advanced capabilities across primary care, capabilities such as advanced CDS, advanced research and RWE, and clinical specialty, were rarely offered.

Fundamental capabilities are covered widely across other use cases except primary care users' outpatient care. A further split, in Figure 12, shows the proportion of market (by revenue) for EHRs that support foundational capabilities in each user group. Order management capabilities are supported by products with 68% of market share and basic reporting and analytics capabilities are only supported by products with 39% of the market share in those products that focus on serving primary care outpatients. In addition, those primary care products that support a mix of inpatient and outpatient use cases, currently have a gap in providing data model capabilities.

Figure 12. EHR solution revenue by supported fundamental capabilities, split by user focus. Excluding products not currently present in the Norwegian market
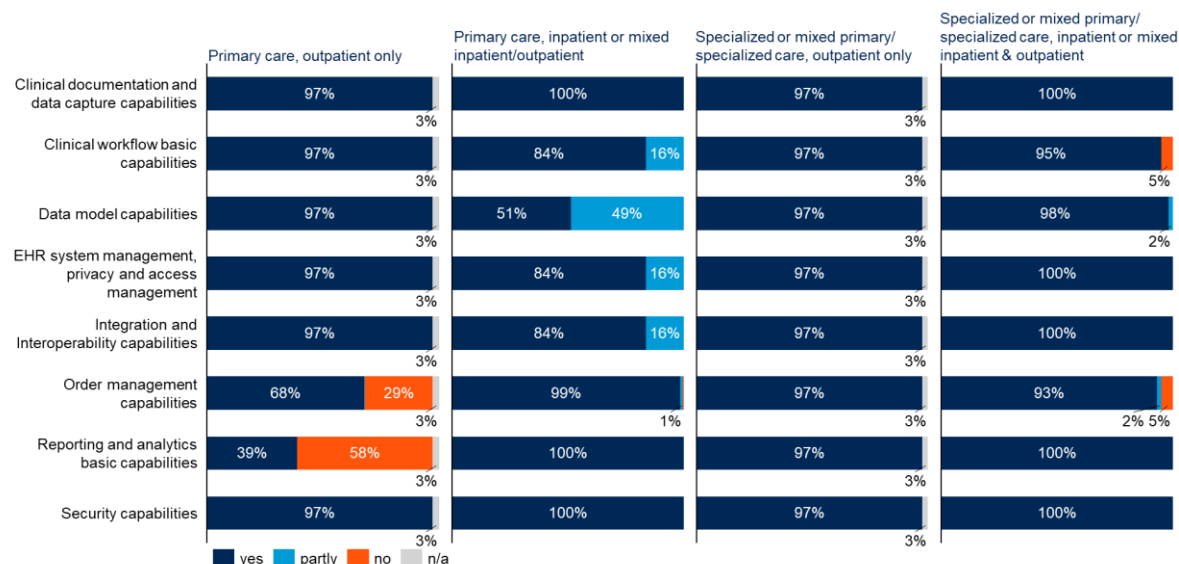

Additional capabilities for primary care outpatient use cases are lacking the most when looked from the perspective of market share. Figure 13 shows the proportion of the market (by revenue) that support additional capabilities in each user group. Although offering fairly good coverage across other capabilities, those EHRs serving a mix of inpatient and outpatient use cases, have a gap in their advanced clinical decision support capabilities. Those EHRs that serve both primary and specialized care with an outpatient focus, do not in general have

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clinical research and RWE and advanced reporting and analytics capabilities. Those EHRs serving both primary and specialized care with a mix of use cases, have only partial support for basic and advanced clinical decision support and clinical workflow capabilities.

Figure 13. Capabilities supported by major EHRs (in terms of revenue) split by user focus. Excluding products not currently present in the Norwegian market

Does your EHR system have the following capabilities?
Percentage the EHR solution revenue in Norway (%)
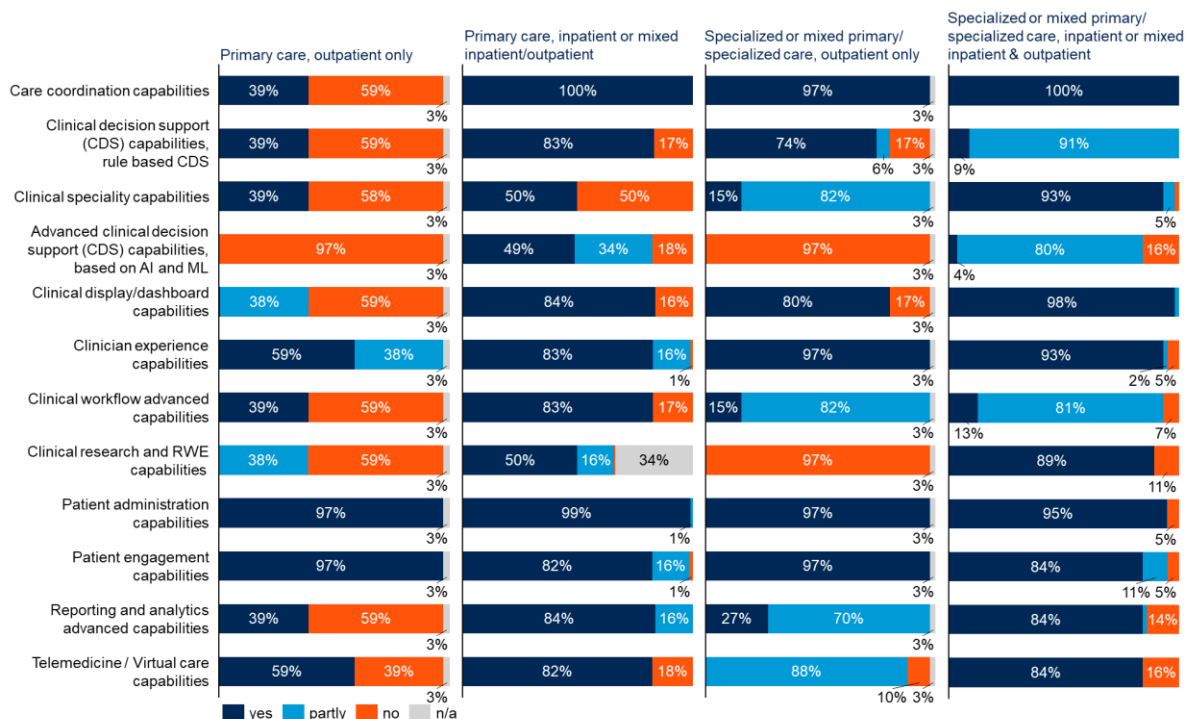
Percentages may not add up to 100% because of rounding.

2.4.5. Observed EHR solution integration capabilities

Overall, most EHR solutions covered in this survey offer integration support for both traditional approaches, such as application-to-application integration and data transfer, as well as more modern technologies such as APIs, integration platforms and cloud integrations. For the most complex use cases, some of the available EHR solutions allow tight integration with other applications, contextual integration such as carry over of role based permissions when launching other applications within the product, integrations with the Microsoft Office product family and connections with other third party modules.

In this survey there were six different integration-patterns identified for which the vendors were asked to state if their EHR solution provided support:

- *Application-to-application integration* referring to traditional mechanisms to build integrations directly between two or more applications.

- *Centralized or de-centralized APIs* referring to support for an API driven integration approach.

- *Openly documented and available APIs (Open APIs)* referring to those APIs documented and aimed for third parties to easily connect to the EHR solution from other applications.

- *Cloud integration* referring to integrations that leverage cloud platforms or existing technologies provided by the cloud provider to create integrations between solutions.
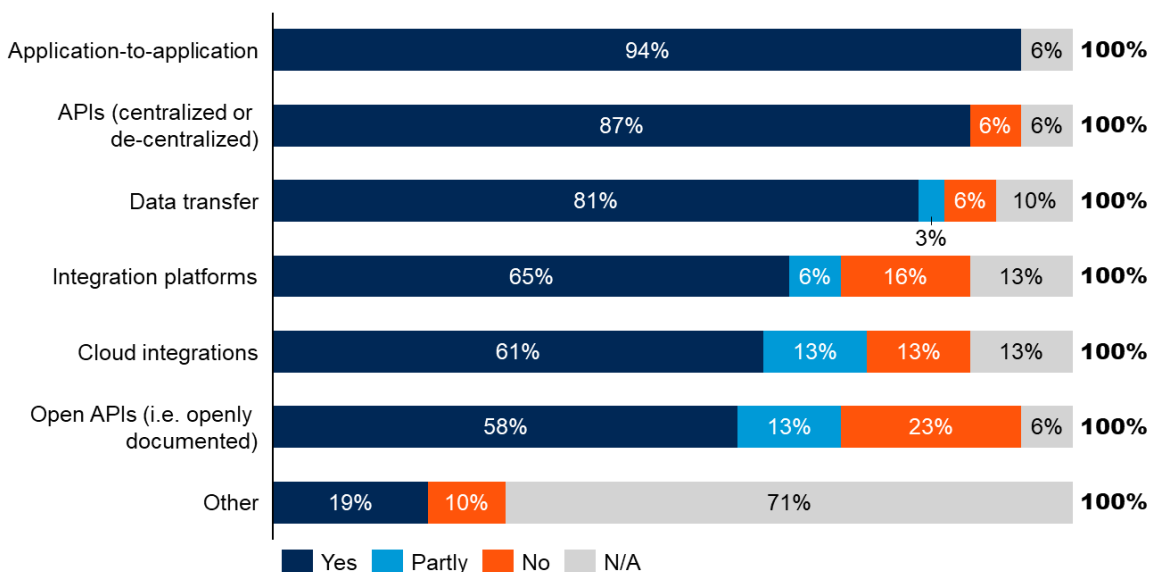
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- *Integration platforms* referring to dedicated software platforms to create and configure integration between two or more applications.

- *Data transfer* referring to technologies used to exchange data files between systems, including XML data transfers and shared file repositories.

Almost all EHR solutions provide support for application-to-application integrations (94%), centralized or de-centralized APIs (87%) and data transfer (81% of products fully supporting this, whereas 3% offering partial support). The least supported integrations were support for open APIs (58% of products supporting fully and additional 13% supporting partially), support for cloud integrations (61% of solutions supporting fully and additional 13% supporting partially), and support for integration platforms (65% of products supporting fully, and additional 6% supporting partially).There were also additional integration options offered, listed as "other" that included XML message transfer and EHR solutions designed to act as platform-type solutions. Figure 14 shows the integration types supported by EHRs.

Figure 14. Overview of EHR solutions' support for integration types, including products not currently present in the Norwegian market

Does your EHR system support these integration types
Percentage of EHR solutions (%), n=31

Integration type	Yes	Partly	No	N/A	Total
Application-to-application	94%			6%	100%
APIs (centralized or de-centralized)	87%		6%	6%	100%
Data transfer	81%	3%	6%	10%	100%
Integration platforms	65%	6%	16%	13%	100%
Cloud integrations	61%	13%	13%	13%	100%
Open APIs (i.e. openly documented)	58%	13%	23%	6%	100%
Other	19%		10%	71%	100%

Legend: ■ Yes ■ Partly ■ No ■ N/A

Percentages may not add up to 100% because of rounding.

In summary, most EHR solutions covered in this survey offer integration support for both traditional approaches, such as application-to-application integration and data transfer, as well as more modern technologies like APIs, integration platforms and cloud integration. For the most complex use cases, there are EHR solutions available that allow tight integrations with other applications: can launch other applications within the solution, integrate with the Microsoft Office product family and connect to third party systems and modules.

2.4.6. Observed hosting types

The increase of cloud and web-based services is apparent in multiple industry verticals. The EHR solutions covered in this report are delivered using a range of hosting types. SaaS is most widely offered approach for solutions meeting the outpatient use cases whereas the on-premises solutions are more typical for inpatient or for the mix or inpatient and outpatient use cases. The EHR solution vendors were asked what hosting options were supported for each EHR solution. The vendors were given four options:

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- *Software-as-a-Service, SaaS (Shared instance)* refers to a model where the solution is hosted in a cloud and the same instance of the solution is used by the customer base. SaaS EHR solutions are hosted on remote servers, and users access the software over the internet. The data is stored on servers in a data center, and users access the data through a web interface. This option eliminates the need for organizations to invest in hardware and maintenance and can be more cost-effective than client-server solutions.

- *Software-as-a-Service, SaaS (Client specific instances)* refers to a model where the solution is hosted in a cloud, but each of the client organizations have their own instance. Similar to shared instance, the solution is hosted on remote servers, and users access the software over internet. The data is stored on servers in a data center and users access it via web interface. The key difference is that each organization has a copy of the system so that application, datastore and compute/storage resources are not shared. In this option, a database only holds information for one organization instead of many.

- *On-premises* refers to an option where the software is installed on individual computers and servers within a healthcare organization. The software is accessed by users through a web interface or a locally installed client application. Data is typically stored on a central server, and users access the server over a network to view and update patient records. This option can provide organizations with greater control over their data and IT infrastructure, but it also requires a significant investment in hardware and maintenance.

- *Other* refers to any other type of hosting model offered by the vendor, including a hybrid model offering a combination of these hosting types.

Most of the EHRs are hosted either as SaaS shared instance (53% of the products fully with 3% partially) and on-premises (53%). The vendor responses to the different hosting types offered for their EHR solutions are shown in Figure 15. Most often, the vendors offer products either to be hosted on-premises or as SaaS, and some EHRs provide both these options. SaaS with client specific instances is fully offered for only 29% of the solutions and an additional 6% offer this as a partial option. Vendors were also able to identify other types of hosting offered. These responses include a number of combinations, such as maintaining client data on-premises while the rest of the solution is hosted in a cloud; hosting the solution in private server or as fully web-based service; and enabling access to the EHR via Citrix.

Figure 15. Overview of the hosting types offered for EHR solutions, including products not currently present in the Norwegian market

Please describe the hosting options available for your EHR solution
Percentage of EHR solutions with the selected hosting type (%), n=32
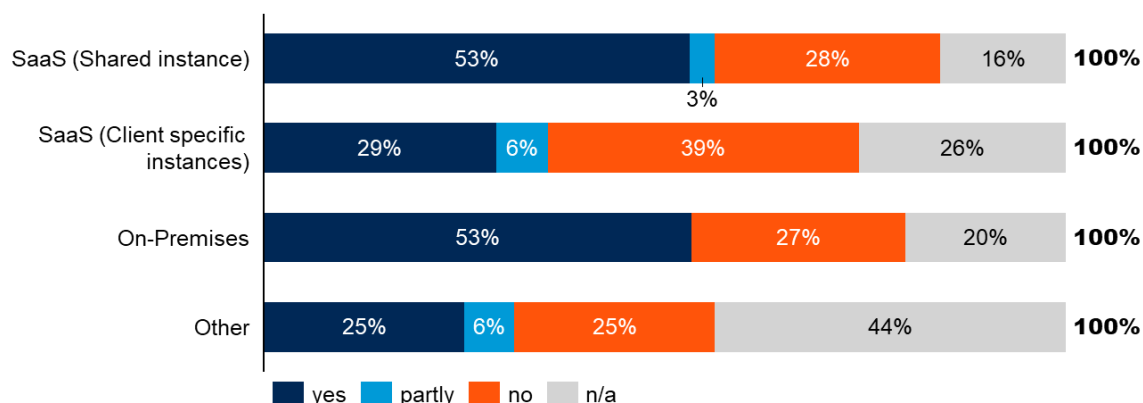
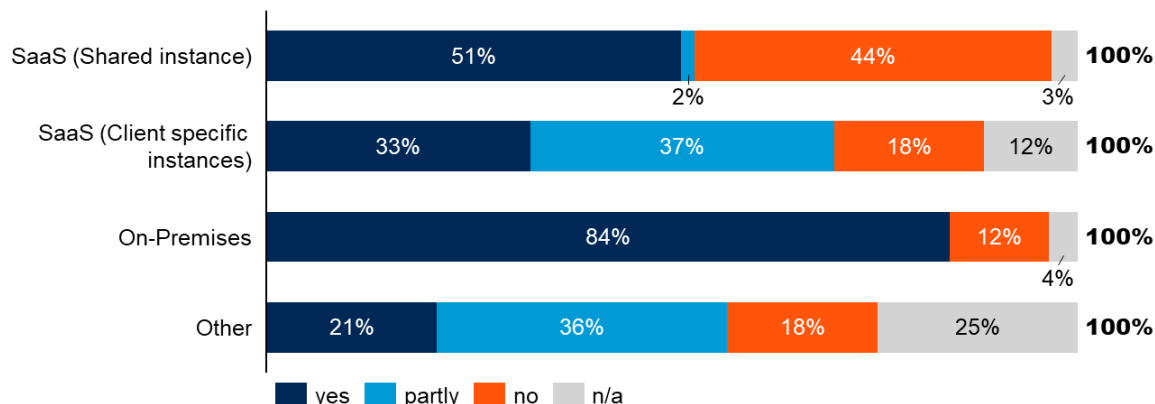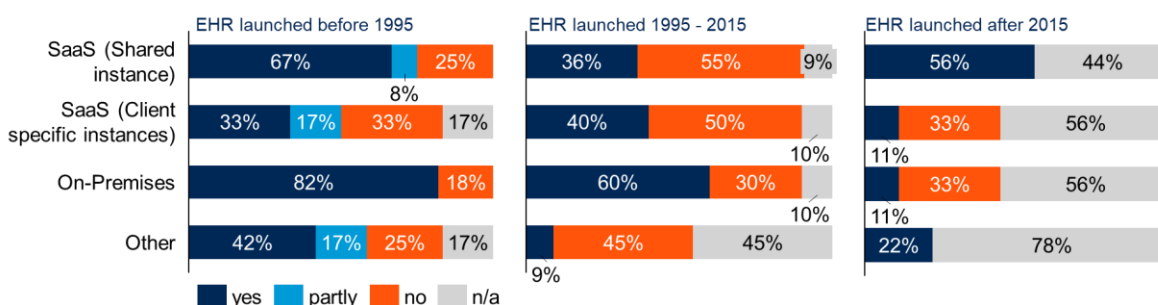
Percentages may not add up to 100% because of rounding.

When considering market share, on-premises solutions predominate, followed by SaaS solutions. Figure 16 shows the proportion of the total market (by revenue) that offers each of the different hosting options. The EHR products that can be hosted on-premises currently

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generate most of the revenue (84%), followed by SaaS with shared instance hosting (51% with an additional 2% partially offering that option) and SaaS with client specific instances (33% with an additional 37% partially offering that option). It is important to note that options are not exclusive, i.e., products offered as on-premises may also be available as SaaS.

Figure 16. Overview of different hosting types supported by major EHRs (in terms of revenue), excluding products not currently present in the Norwegian market

Please describe the hosting options available for your EHR solution
Percentage the EHR solution revenue in Norway (%), n=30

Percentages may not add up to 100% because of rounding.

The high market share of the products that offer on-premises hosting as an option may indicate a high number of legacy applications traditionally hosted on-premises. Figure 17 shows the percentage of products available under each hosting option against the year in which the vendor first sold an EHR solution. This shows that the highest percentage (82%) of EHRs supporting an on-premises option are offered by vendors that have been present in the market since 1995 or earlier.

Figure 17. Hosting option supported by EHRs, grouped by the year the vendor has sold its first EHR solution

Please describe the hosting options available for your EHR solution
Percentage of EHR solutions with the selected hosting type, grouped by the year the vendor has sold its first EHR (%), n=32
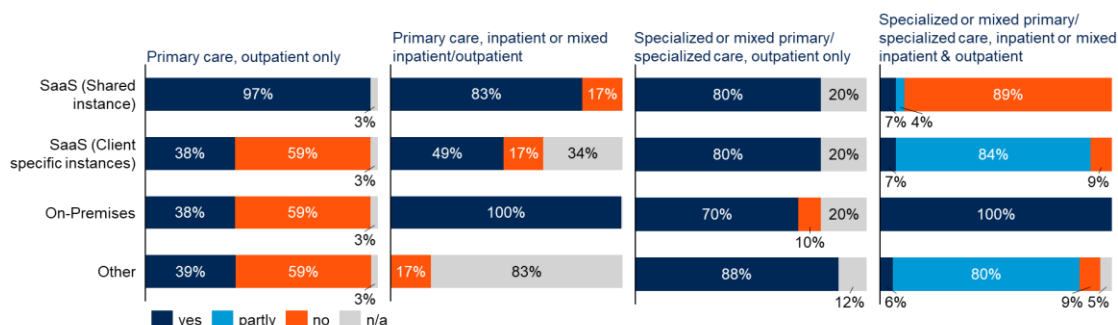

Percentages may not add up to 100% because of rounding.
Note: Indicative only. The year the first EHR solution sold is not necessarily the launch year of the EHR in question.

The next graph shows another view of hosting options available by user segment / use case, again based on market share (revenue). Figure 18 shows that SaaS is most widely offered as the hosting option in primary care and outpatient only use cases. Specifically the primary care, outpatient only use case is primarily served by shared instance SaaS and in the mix of primary and specialized use cases, by both shared and client specific instance SaaS. The on-premises solutions, however, are most widely offered in solutions aimed for specialized and primary care and its outpatient and inpatient use cases.

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Figure 18. Revenue generated by EHRs supporting different hosting types, excluding products not currently present in the Norwegian market

Please describe the hosting options available for your EHR solution
Percentage the EHR solution revenue in Norway (%)

Percentages may not add up to 100% because of rounding.

2.4.7. Observed architectural types in the EHR solutions

EHR solutions have various solution architectures depending on the requirements of end users. Most EHRs utilize a combination of different architectural elements.

In this survey, four architectural patterns were presented. Vendors then selected the architectural pattern that applied for their EHR solution. The four patterns were:

- *Single application suite architecture* which refers to monolithic architecture that is a unified, self-contained application.

- *Modular product suite* which refers to modular architecture, where the EHR solution consists of smaller, independent components that can be combined to a larger system.

- *Platform architecture* which refers to solutions acting as a platform on which additional functionality can be developed or added, including third party provided functionality.

- *Hybrid architecture* (i.e., combination) which refers to any combination of the other architectural options above.

When asked to identify a single pattern, most EHR solutions use a hybrid architecture, i.e., two or more types of architecture, as shown in Figure 19, and only 14% of the vendors utilize one type of architecture exclusively. Furthermore, the observation from the analysis is that the EHR vendors are transitioning from monolithic architectures to modular and platform architectures.

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Figure 19. Overview of the architectural types used in EHR solutions, including products not currently present in the Norwegian market[5]

Please describe the architecture of your EHR system
Percentage of EHR solutions products exclusively utilizing one type of the architecture (%), n=31
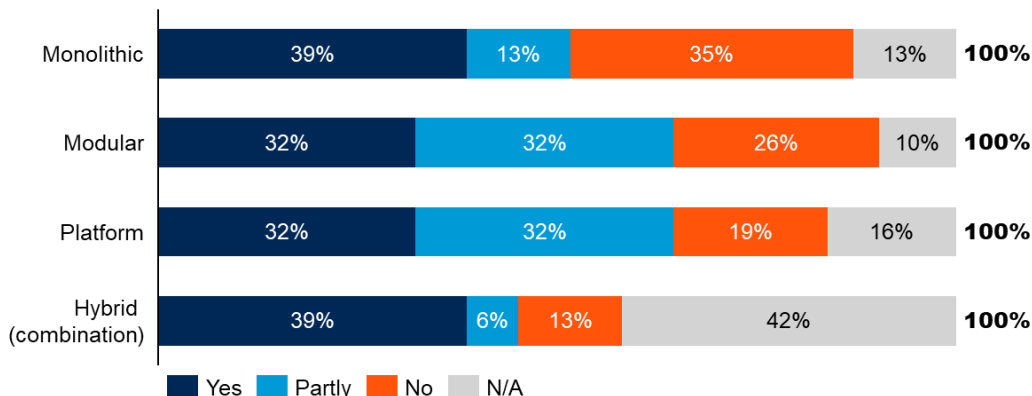
Architecture type	Percentage
Monolithic (purely)	7%
Modular (purely)	0%
Platform (purely)	7%
Hybrid (Combination)	86%

When asked about the combination of different architectural types used, however, there is a more distributed adoption across the solutions. Figure 20 shows the architectural types used in the hybrid scenario, indicating that the different types of architectures are quite evenly supported, with none being particularly more common than the rest (EHRs utilizing 32% to 39% of each architecture option provided).

Figure 20. Overview of the architectural types used in EHR solutions, including products not currently present in the Norwegian market

Please describe the architecture of your EHR system
Percentage of EHR solutions with the selected architectural type (%), n=31

	Yes	Partly	No	N/A	Total
Monolithic	39%	13%	35%	13%	100%
Modular	32%	32%	26%	10%	100%
Platform	32%	32%	19%	16%	100%
Hybrid (combination)	39%	6%	13%	42%	100%

Percentages may not add up to 100% because of rounding.

2.4.8. Observed EHR solution compliance with the standards

The responses show that, in general, vendors present in the Norwegian market understand that it is critical to support compulsory national standards, and that there is an increase in attention towards support for recommended standards. Thus, a focus on recommended standards steers the development plans of many of the products that do not offer this support yet. In addition, the responses show that, for new vendors planning to enter to the Norwegian market, development efforts are required to ensure EHR solutions meet local standard requirements.

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[5] *If a vendor has responded that they utilize an architecture type (fully or partly) they have been included in the count for that architecture type. Individual vendors have been counted on several architecture types as they often utilize more than one type. The category "Hybrid" represents the survey option "Combination" that was also available to the respondents.*

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Vendors were asked to provide information on their solutions' support for compulsory and recommended standards in Norway as well as for additional standards such as international standards. These standards were defined as follows:

- *Compulsory standards* referring to the standards that are mandatory for EHR solutions to support, described in https://lovdata.no/dokument/SF/forskrift/2015-07-01-853, and including for example messaging standards like e-prescription and lab test orders, and classifications like ICD-10 or ICPC-2.

- *Recommended standards* referring to those listed fully on https://www.ehelse.no/standardisering/standarder, and including examples such as IHE / IHE XDS, ISO 13606 & openEHR Archetypes, Health Level Seven (HL7) Fast Healthcare Interoperability Resources (FHIR), SMART-on-FHIR and SNOMED CT as well as category "other" to specify additional standards they support.

- *Additional national or international standards* referring to any standards the vendors might find relevant but were not compulsory or recommended standards in Norway.

Support, either fully or partially, for Norwegian mandatory standards were offered in the vast majority (87%) of the solutions as shown in Figure 21. Most EHR solutions support the compulsory standards in Norway (74%). A few indicate partial support for these standards (13%). A portion of vendors (10%) reported that their EHR solution does not support Norwegian standards, potentially because these solutions have not yet been made available to Norwegian customers, and thus, support for those standards has not been prioritized in their product development. Meanwhile, some vendors (3%) did not provide any information regarding the mandatory standards.

Figure 21. Overview of EHR solutions' support for standards, including products not currently present in the Norwegian market

Does your EHR system support the standards
Percentage of EHR solutions (%), n=31
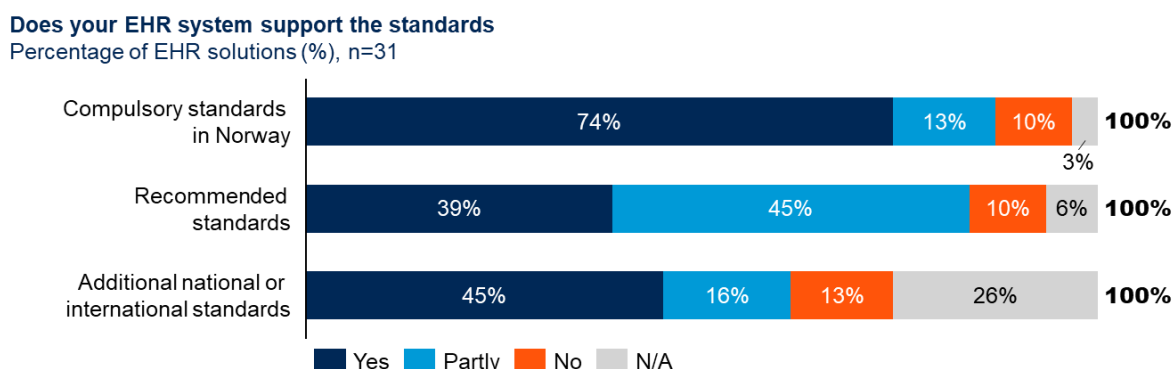
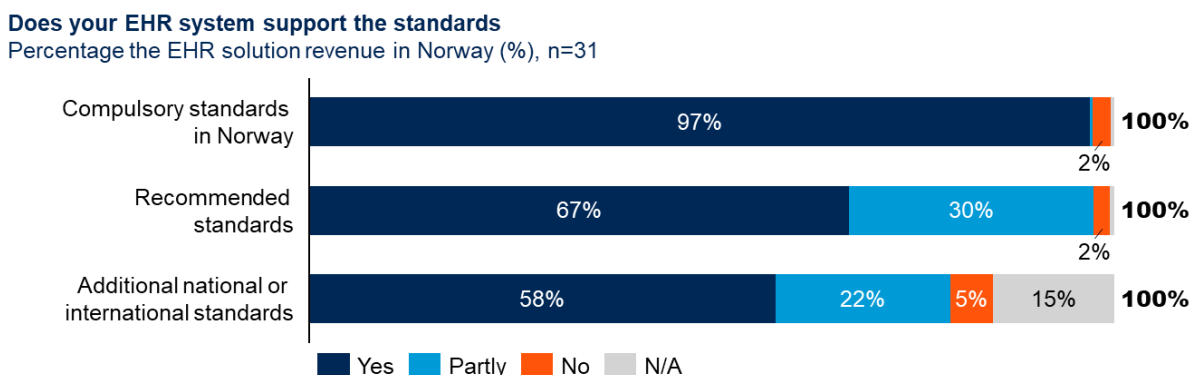Percentages may not add up to 100% because of rounding.

Support for recommended standards, either fully or partially, was also seen in the vast majority (84%) of the products, as shown in Figure 21. Full support for these standards was stated for 39% of the EHR products, whereas almost half (45%) of the products partially support these standards. However, many of the answers in the group answering partial support emphasized that there are plans or already ongoing development to provide the support in future, for instance, for HL7 FIHR and APIs, and ICT and SNOMED CT. Again, 10% of the EHR products did not provide support for these standards and the information was not disclosed for 6% of the products.

Additional national and international standards were supported by 45% of the products fully and 16% of the products partially. No support was stated for 13% of the products and for 26% of the solutions, this information was not disclosed.

The strong support for compulsory standards, which is expected, is even more apparent when looking at how widely these solutions are in use. Figure 22 shows the market share (by

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revenue) for EHR solutions and the support for different standards: as much as 97% of the market is based on products that support compulsory standards, and 67% from EHR products that support recommended standards fully with an additional 30% from products that support those standards partially. Full support for additional national or international standards is provided by 58% of the market with an additional 22% by products that offer partial support for those.
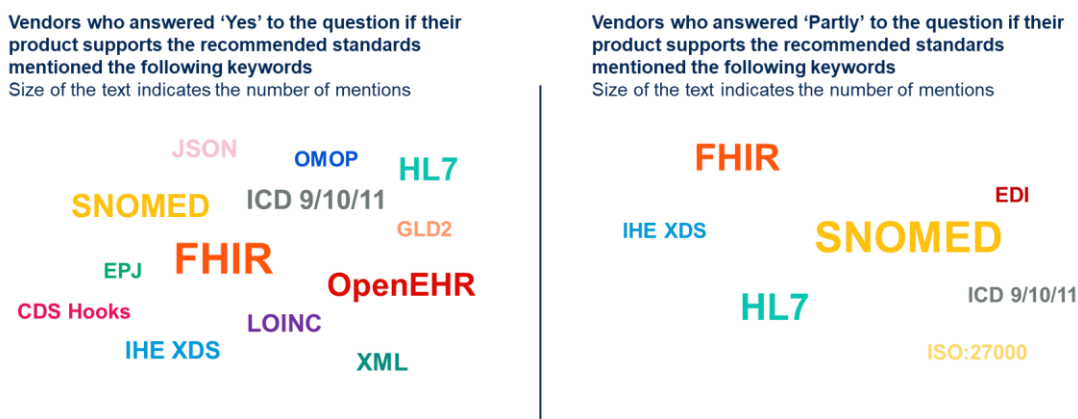
Figure 22. EHR solution's support for standard in relation to revenue, excluding products not currently present in the Norwegian market

Does your EHR system support the standards
Percentage the EHR solution revenue in Norway (%), n=31

Compulsory standards in Norway	97%	100% / 2%
Recommended standards	67% / 30%	100% / 2%
Additional national or international standards	58% / 22% / 5% / 15%	100%

Legend: ■ Yes ■ Partly ■ No ■ N/A

Percentages may not add up to 100% because of rounding.

Vendors that already support recommended standards mentioned common ones for intra- and interoperability, such as SNOMED and HL7 FHIR, as well as integration technologies to enable the same aim. In addition, vendors, that support these technologies partially, had multiple references to SNOMED, FHIR and HL7. Figure 23 shows which recommended standards are a current development focus for EHR vendors.

Figure 23. An overview of which standards are the radar for further focus

Vendors who answered 'Yes' to the question if their product supports the recommended standards mentioned the following keywords
Size of the text indicates the number of mentions

JSON OMOP HL7
SNOMED ICD 9/10/11
GLD2
EPJ FHIR OpenEHR
CDS Hooks LOINC
IHE XDS XML

Vendors who answered 'Partly' to the question if their product supports the recommended standards mentioned the following keywords
Size of the text indicates the number of mentions

FHIR
EDI
IHE XDS SNOMED
HL7 ICD 9/10/11
ISO:27000

2.5. Vendor approaches to service delivery

This chapter discusses how vendors that are present in or that aim to enter the Norwegian EHR market deliver their solutions, including:

- *Observed partnership models used for solution delivery*
- *Observed hosting types*
- *Observed pricing models*
- *Observed approaches to ensuring customer experience.*

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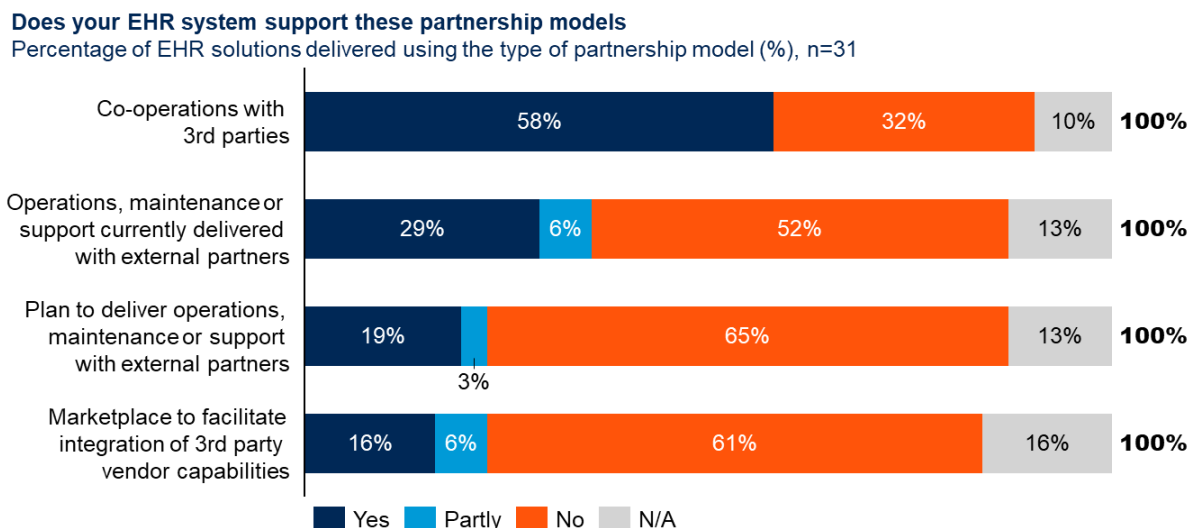## 2.5.1. Observed partnership models for solution delivery

EHR service delivery can be done either entirely with a vendor's in-house resources or through a combination of in-house resources and vendors relying on external parties providing various elements of the services, including operations, maintenance, or support. There are several drivers for seeking to collaborate with third parties. For example, high levels of complexity of EHR solutions sometimes require additional parties such as system integrators to work in close collaboration with the EHR solution vendor and the customer. The vendor may also have limited presence in Norway which can be complemented by operations, maintenance, or support collaboration. In some cases, the solution is a platform by design and is meant to interconnect with third party systems built on top of the platform functionality.

For this report, vendors were asked about their approach to the service delivery using four dimensions:

- *Co-operation with 3rd parties* with the aim to provide an overview to which extent the EHR solution vendors relied on any 3rd party in their service delivery approach.

- *Operations, maintenance, or support that is currently delivered with external partners* with the aim to provide visibility into how widely EHR solution vendors have engaged in partnerships to deliver their core service delivery.

- *Plan to deliver operations, maintenance, or support with external partners* with the aim to understand whether there is a market dynamic encouraging vendors to increasingly engage in partnerships models for their core service delivery.

- *Marketplace to facilitate integration of 3rd party vendor capabilities* with the aim to bring visibility into to what extent current EHR solution vendors have identified opportunities from engaging into a platform business to enhance their service delivery.

The responses show that over half of the EHR solutions leverage some sort of co-operation model as shown in Figure 24. 58% of the EHR solutions vendors stated that they co-operate with third parties, ranging from hosting partnerships to core service delivery and to innovation and R&D collaboration models. When it comes to core service delivery by offering operations, maintenance, or support, 29% of the EHR products have partnerships in place to enhance the delivery. In addition, for 19% of their EHR products, the vendors have stated they have plans to establish new partnerships to deliver operations, maintenance, or support. In the case of some EHR products, the answer refers to new plans and for some others, the answers refer to expanding existing partnerships already in place. The existence of marketplaces to facilitate integration of 3rd party vendor capabilities is in the minority with 16% of the EHR products having such a marketplace available, and one being planned for an additional 6%.

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Figure 24. Overview of partnership models used for EHR solution delivery, including products not currently present in the Norwegian market

Does your EHR system support these partnership models
Percentage of EHR solutions delivered using the type of partnership model (%), n=31

Percentages may not add up to 100% because of rounding.

The responses regarding how widely and what types of partnership models are being used by EHR vendors indicate that many of the vendors have the in-house capabilities to serve Norwegian clients (e.g., the language barrier not pushing vendor to seeking partnerships to provide first line support), which can be explained by the relatively strong presence of the Norwegian EHR solution providers in the market. Co-operation, especially with cloud hosting partners including the cloud hyper scalers, such as AWS, Azure, and Google, indicate a shift towards SaaS and Web-based delivery models.

2.5.2. Observed pricing models

The pricing of an EHR solution tends to vary from simple pricing plans, typically available for smaller patient record products, to complex combinations typically observed with the most extensive EHR solution suites. There is also a lot of variance when it comes to vendors' willingness to offer discounts for their products.

Larger EHR vendors have a complex pricing model that includes perpetual licenses based on multiple factors such as the number of users or patients, organization size, system usage, and optional hosting. They also offer development and testing environments for users to configure and integrate the solution. While some vendors include maintenance and support services in their pricing, others charge extra fees based on the size of the implementation.

Pricing options for SaaS based suites are often subscription-based models either monthly or on the specified term. Some vendors have added a startup price, but that is not the case for all the SaaS type providers. There are also a variety of factors that drive the price tier that sets the level of the subscription fee, such as the size of the organization or the number of the EHR solution users or full-time equivalent workers. In addition, the price tiers may be offered to cater to different levels of breadth and depth of the functional capabilities required from the solution for a specific use case. Some vendors aim to offer a pricing model that follows many of the subscription services consumers are accustomed to and that is easy to understand.

Pricing options for on-premises suites often use a combination of perpetual license and annual fees, driven by metrics such as number of transactions, number of active users or individual patients, beds, visits, organization's type, etc. In some cases, even permanent organizational licenses may be offered.

Additional options, such as consulting services, implementation and configuration support are offered by many of the responding vendors. Typically, billing is done on a time and material

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basis. The amount of work needed for these services is heavily driven by the use case and organizational complexity. Some solutions aim to provide low barriers for taking them into use.

2.5.3. Observed approaches to ensuring good customer experience

Focus on improved customer experience is a clear global trend for EHR solutions. For this report, EHR solution vendors were asked what activities they take with their EHR solutions to ensure good customer experience. The vendors were presented with four questions:

- *Do you conduct regular customer satisfaction surveys such as Customer Satisfaction Score or Net Promoter Score (NPS)?*

- *Do you measure customer satisfaction in the same way across all EHR clients and regions?*

- *Are your teams held accountable for improved customer satisfaction?*

- *Are your teams rewarded for improved customer satisfaction?*

Responses show that almost half (48%) of the EHR solution vendors fully leverage these four methods to drive and ensure their customer satisfaction. As shown in Figure 25, customer satisfaction surveys are regularly conducted for 48% of the EHR solutions fully and for 16% partially. Surprisingly, for 19% of the EHR products, customer satisfaction is not measured through regular surveys. Instead, vendors may use other means to connect with customers to gather feedback. An alternative explanation could be that vendors don't consider it worthwhile tracking customer satisfaction for solutions at the end of their lifespan. The methods used to measure also vary; for 48% the customer satisfaction measurement is unified across EHR clients and regions, and for additional 6% there means to measure are partly the same. Interestingly, 16% of the products have different customer satisfaction measurements depending on the client or the region.

Figure 25. Overview of customer experience activities, including products not currently present in the Norwegian market

Does your EHR system support these customer experience activities
Percentage of EHR solutions' customer experience activity (%), n=31
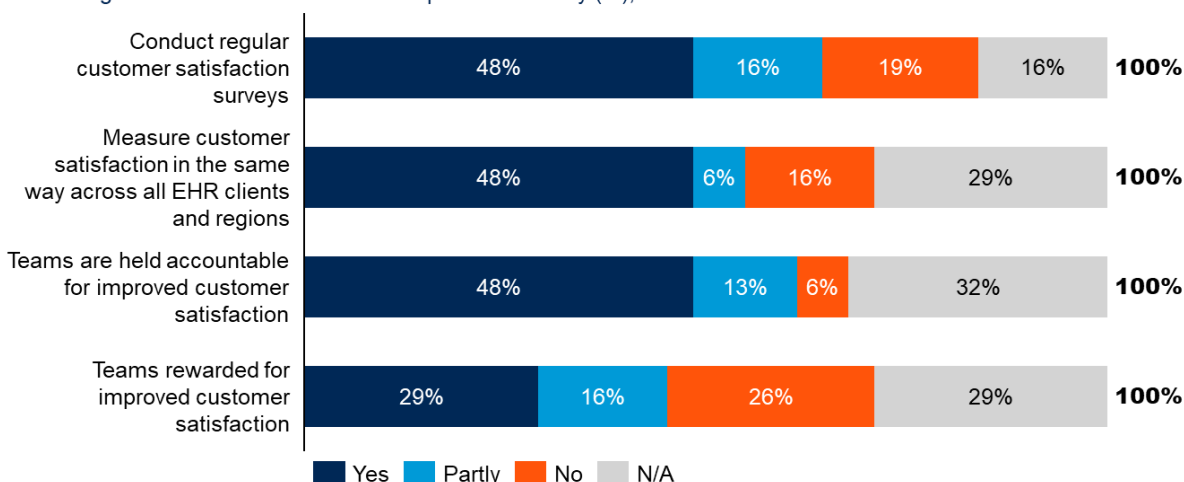
The responses (Figure 25) also express that teams are held accountable for improving customer satisfaction to different degrees; for 48% of the EHR product vendors, the teams are held fully accountable, and an additional 13% partially. Only 6% of products' do not keep their teams accountable for improving customer satisfaction. However, accountability does not directly impact team rewards, as only 29% of the EHR product vendors reward their teams for

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improved customer satisfaction fully, and additional 16% partially. For as many as 26% of the vendors, the improvements in the customer satisfaction are not reflected in teams' rewards.

The products using the most extensive focus on customer satisfaction are typically the most extensive product suites with high market shares serving both inpatient and outpatient use cases, followed by products focusing on primary care outpatient users. For those products holding a large market share serving a mix or specialized and primary care users in outpatient use cases, vendors did not disclose this information. Figure 26 shows the different approaches to improving customer satisfaction are used in different user groups / use cases (by market share).

Figure 26. Revenue generated by EHRs utilizing different means to improve customer satisfaction, excluding products not currently present in the Norwegian market

Does your EHR system support these customer experience activities
Percentage the EHR solution revenue in Norway (%)
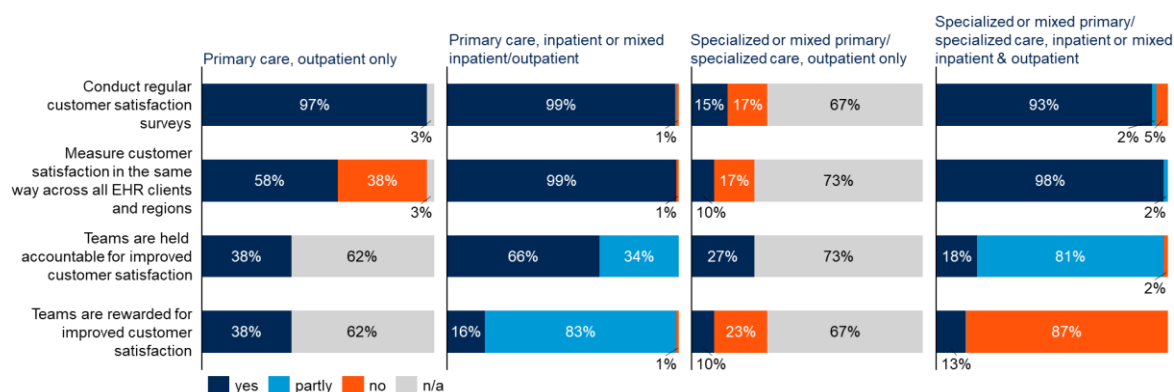
2.6. Vendor approaches to innovation and R&D

For this report, the EHR solutions vendors were asked questions about their innovation and R&D activities. There were four main questions asked related to them:

- *How much they invest into innovation as % of their revenue*

- *What models and methodologies they use to drive innovation*

- *Are product roadmaps being in use to steer the development of new product functionalities*

- *Are innovation boards used, and if they are, what is the composition of the innovation board*

This section outlines the innovation efforts observed in the Norwegian market by looking at the investments into innovation as well as the R&D and methodologies vendors implement for their innovation efforts.

2.6.1. Observed investments into innovation

There is a varying level of investment into the EHR solutions observed in Norway. Based on the responses, the average investment as part of the revenue is 10%. Investments into innovation and R&D show different patterns among the vendor's size and geographic footprint.

Global megasuites and European EHR invest significantly more aggressively in their innovation and R&D than local and specialist vendors. As shown in Figure 27, these vendors invest an average of 21,5% of their revenue. Although these vendors have size and scale to afford specific innovation and R&D facilities, the innovation, in some cases, is driven by the requirements to comply with the local standards and regulations, often prerequisite for moving into new geographies. Norwegian EHR vendors invest, on average, 10,3% of their revenue

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back into their products. It is noteworthy that this group contains a wide range of vendors from startups developing their products to more mature vendors that have a portfolio of solutions, of which are at the end of their life and hence are not an investment priority for further development. The Norwegian Specialist EHR vendors are a group investing on average only 0,5%.

Figure 27. Average investment into innovation and R&D as part of the vendor type and geographic footprint, including products not currently present in the Norwegian market

How many percentage of the EHR products revenue are you using towards innovation on EHR products?
Percentage of revenue (%), n=16
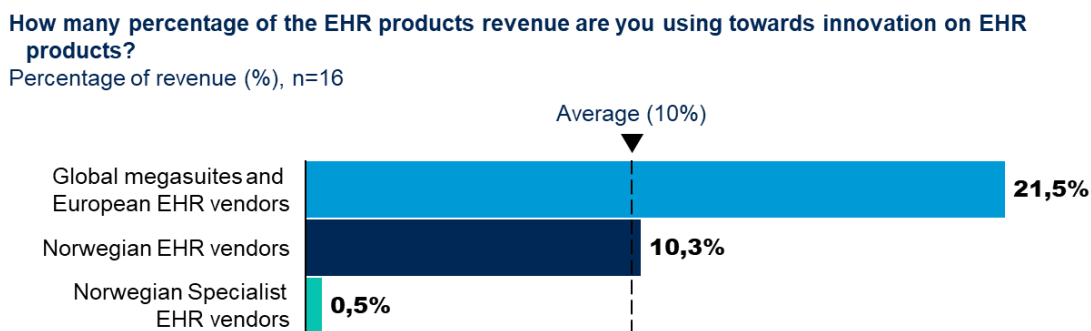
Distinct innovation patterns are observable within the Norwegian market: smaller vendors typically innovate to client demand, emphasizing close customer proximity and agility to respond to the changes. The size and scale of the vendor may not allow high investment in innovation and R&D. Larger vendors have more extensive R&D and innovation capabilities.

International vendors must develop their EHR products to meet the local requirements when they expand to new markets. The lifecycle stage of a product dictates the investment into that product: for those EHR solutions at the end of the lifecycle, innovation efforts are kept to a minimum.

2.6.2. Use of models and methodologies to drive innovation

The majority of the vendors responding to this market survey outline multiple methodologies to innovate, including collecting requirements and feedback from internal and external parties, prioritizing the product roadmaps and applying other tools and methodologies to drive their efforts.

Some common themes across the vendors are observable, as shown in Figure 28, in the summary of open comments provided by vendors. Vendors emphasize the importance of being able to translate user needs into features as well as tie these into their product development agenda. Some vendors focused their efforts into closely listening and monitoring customer and user needs, whereas other engaged a wider community of actors utilizing e.g., open innovation, collaboration with government and research organizations.

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Figure 28. Methodologies utilized by vendors for their innovation efforts

Please describe the model you prioritize different product development ideas / innovation?
Do you use an industry-standard model, and if yes, what?
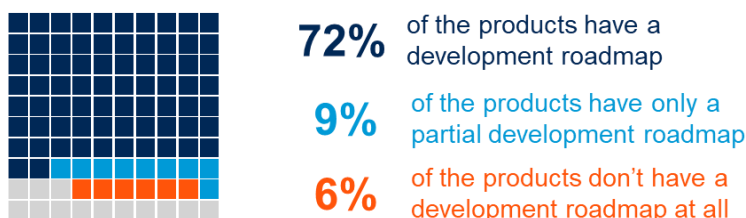Size of the text indicates the number of mentions

Sprints   User representative bodies   Research projects
Customer collaboration   Governmental collaboration
/ listening   Agile   **Scrum / Kanban**
Value based
thinking   Strategic roadmap   **Prioritization**   Customer community
Internal and external insight   Open innovation
Design thinking   Business case   Business model canvas
Product teams
User / customer forums

2.6.3. Use of product roadmaps to steer development

The vendor responses show variation in the maturity of EHR product development efforts. Most vendors utilize a formal product development roadmap that includes the capabilities and features the vendors are planning on implementing.

How widely formal product roadmaps are used is shown in Figure 29. Of the products covered in the survey, 72% had a product development roadmap varying from several months into multiple years. Of the products, 9% had only a partial product development roadmap and only 6% of the products did not have a development roadmap to steer the development. Instead, these vendors have stated that they use pre-defined product versions especially in the case of newly established products, or innovate directly in response to arising user needs, emphasizing the good customer collaboration and ability to develop changes to their EHR solution quickly if requested by their customers. The remaining 13% of the products did not have information disclosed as to whether those products had a roadmap.

Figure 29. Percentage of EHR solutions with a formal product roadmap, including products not currently present in the Norwegian market

Do you have a formal product roadmap including the capabilities and features, you plan on implementing?
Percentage (%) vendor responses, n=32

72% of the products have a development roadmap

9% of the products have only a partial development roadmap

6% of the products don't have a development roadmap at all

2.6.4. Use of innovation boards to steer innovation activities

Innovation boards represent another formal method vendors may use to steer their innovation and R&D activities. However, the use of innovation boards to steer the development of the EHR solutions is not as widely used among the respondents.

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As shown in Figure 30, only 41% of the products have an innovation board that oversees their development, and only an additional 13% have a partial implementation of an innovation board. The responses for 3% of the EHR solutions state that there is no innovation board in use at all, assumably because these are predominantly smaller vendors' products. The remaining 43% of the responses did not disclose information about the use of innovation boards.

Figure 30. Percentage of EHR solutions which development is steered by an innovation board, including products not currently present in the Norwegian market

Presence of an innovation board
Percentage of EHR solutions (%), n=32

	Yes	Partly	No	N/A
Set frequency for the innovation board meetings	41%	13%	3%	43%
Innovation board has a medically trained person	50%	3%	3%	44%
Innovation board has a user / customer representative	53%	6%	3%	38%

All rows total 100%.
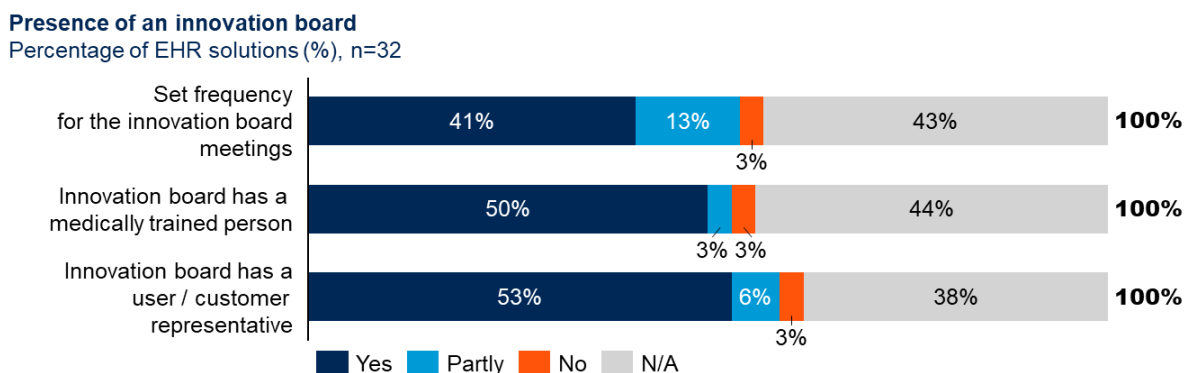
Percentages may not add up to 100% because of rounding.

Vendors, who utilize innovation boards, typically have both a medically trained member and a health person (client and/or end user representative) on the innovation board, including even some of those vendors who only considered themselves having the innovation board in place partially.

2.7. Vendors' current and future plans

This subchapter outlines the vendors current and future plans related to geographic presence and future expansion plans, product and software development direction and other technological developments vendors consider relevant for their EHR products.

2.7.1. Observed focus on geographic presence

To identify patterns and common themes in the vendors' strategic approaches, the vendors were asked to provide information about their current and future plans related to activities in the Norwegian market:

- *Current and future sales and marketing efforts in the Norwegian market*

- *Current and future global strategy and business model strategy.*

Based on their responses, the vendors, that represent either Global megasuites vendors or European EHR vendors, state varying level of sales and marketing efforts in their plans for the Norwegian market. In general, many of the companies in this segment outlined that Norway presents an interesting, mature market in which to keep a foothold. Companies with strong data management and population health capabilities also emphasize eagerness towards opportunities presented by these solutions in addition to their core EHR solutions. Additionally, companies with a large international footprint also outlined other regions that they expect to offer growth opportunities in the very near future.

Those vendors that do not have an existing presence, or that have just entered the market, are looking into increasing engagement with user organizations and authorities and to prioritize efforts into expanding their footprint in the Norwegian market. Furthermore, several EHR vendors have plans to introduce their products from other market into Norway if a suitable opportunity emerges.

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Those vendors already present in the market are looking to expand their presence either via existing market segments or by entering new market segments. Efforts mentioned to do that include, e.g., establishing third party collaborations and partnerships. The Norwegian EHR vendor group has, in general, expressed more pragmatic plans in terms of expanding their foothold in the Norwegian market. Yet some stated that they are also interested in an international expansion. The age of a company often influences its expansion plans. Newer companies tend to focus on enhancing their current offerings to better meet client needs, while older companies with legacy solutions may be considering replacing them with more modern options. A legacy solution refers to an older system or technology that has been in use for a long time and has proven to be reliable and effective. Therefore, a legacy system should not necessarily carry a negative association. While newer technologies may offer more advanced features, a legacy system may still be able to meet an organization's needs and requirements. Additionally, an organization may have invested significant resources in customizing and integrating its legacy systems with other applications, making it difficult and costly to replace the system with a new solution. Some niche providers, such as a dental care provider with international clients in Iceland, have expressed a desire to maintain or grow their market share in their particular care area in Norway, even when presented with international opportunities.

2.7.2. Observed product and software development focus

To identify patterns and common themes in the vendors' product development direction and future plans, vendors were asked to provide information:

- *Current and future software development strategy for EHR systems*

- *Upgrade strategy and release cycle (major vs. minor) and recommendations for customers to handle upgrades*

- *Training methodology and what you require customers to do (if anything)? What suggestions you make to your customers regarding training*

The global megasuite vendors, European EHR vendors and Norwegian vendors in general, state that they have a clear direction for their future product and software development; platform providers are focusing on providing well-rounded health platform products and EHR software providers are focusing on making their existing EHR solutions even better. Depending on the vendor, responses included, for example, strong commitment on research and development, providing support for the functionality and capabilities already in use, and enhancing the existing product by introducing new functionality and capabilities. Some vendors have identified a need to renew their legacy architecture and carve out solutions to support a modular microservice architecture. A shift towards cloud products is moving the vendors away from traditional release cycles into looking for incremental, continuous improvement releases to the customers using their products. The ability of the customers to assess the changes coming in these future releases was acknowledged by many of the vendors to be important.

There is some variation around how the vendors construct their training plans, not only for new customers, but in relation to larger changes in the system such as introduction of a significant new module. The largest vendors, regardless of Global, European or Norwegian, typically have pre-defined, established learning programs and frameworks for the different roles at the customer, including classroom training, web training, training the trainers, blended training combining both online and hands-on trainings, and job shadowing to mention a few. The extensiveness of the training available naturally depends on the breadth and depth of the EHR solutions.

2.7.3. Observed technological development focus

The vendors were also asked to provide their views on the technological developments they see relevant in their current and future plans through three areas:

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- *New technological concepts believed to be relevant for each EHR solution*

- *Role and efforts in analytics and BI (Business Intelligence)*

- *Plans to exploit AI and ML*

The key technological concepts outlined by the vendors were very similar regardless of the vendor's size or geographic footprint. Key themes are improvements in clinician experience and efficiency of using the EHR solution, patient experience, data handling and interoperability often aligned with the compliance with standards and OpenEHR guidelines.

Clinician experience was mentioned multiple times. Improvements in semantic linking and NLP in combination with clinical terminology can improve usability of solutions through intelligent transcribing and intelligent scanning of paper documents. Some vendors also mentioned their plans to enhance user experience and improve efficiency by offering clinicians and other health personnel automated administrative tasks powered by AI and ML technologies and by providing clinicians and developers with low-code development tools.

Patient safety was another theme emerging among the vendor responses, including in many cases potential use of AI and ML. Examples include precision dosing for drugs and voice and ambient listening. Voice and ambient listening refers to the use of voice recognition technology and smart devices to capture patient data such as symptoms, medication use, and lifestyle factors. Voice and ambient listening can also, for example, enable patients to report information to a healthcare provider without the need for manual data entry, potentially improving the accuracy and completeness of patient information in EHRs. Potential improvements in clinical decision support and streamlined care pathways as well as treatment recommendations were also mentioned. Reponses also show a focus on technologies to provide near real time or real time data and real time analytics and insights for care. Worth noting is that while voice recognition systems and other AI technologies have shown promising results in improving patient safety, their effectiveness in EHR systems is still an area of ongoing research and development. There have been studies showing improvements in accuracy and efficiency when using voice recognition for data entry in EHRs, but there are also concerns around errors caused by misinterpretation or misunderstanding of speech, as well as issues with bias and lack of transparency in AI algorithms. Therefore, while these technologies have potential, it is important to continue evaluating and improving their performance in EHR systems to ensure they are safe and effective for patients.

In general, improved data handling capabilities (including use of business intelligence tools, the ability to extract data effectively and to create integrations into other BI systems) is also seen as an important development area. Vendors are planning to add reporting capabilities and connect their EHRs with pre-existing BI solutions, and to enhance other analytics and BI capabilities. However, not all vendors had BI development plans either at company level or for their EHR solution.

Closely connected to improved data handling capabilities, was the overall interoperability of the system, including wide support for established standards (e.g., FHIR, SMART-on-FHIR, SNOMED CT and openEHR) which equip customers and partners with the ability to extend and embed custom capabilities. The responses show that interoperability requirements exist not only between applications but that those are increasingly important to be able to pull information from multiple other sources, including IoT of medical devices and sensors.

Other useful areas for AI and ML were seen in diagnostics, lab and medication use cases. The vendors leading the use of AI and ML technologies already use ML for personalized experiences, probability-based patient experiences and population studies as well as clinical decision support. Some respondents, however, highlighted the need to assess the use of AI and ML against requirements for upcoming regulation.

Some vendors mentioned that for the development of AI and ML based capabilities, they will likely rely on third parties. Others had such initiatives already underway which were expected

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to be used in future in their EHR solutions. Some vendors have internal centers of excellence in this area. In general, there is openness towards developing AI and ML both in-house and through third party collaboration. At company level, EHR vendors leverage AI and ML technologies for e.g., product development and innovation, creating insights on customers / their markets, and use anonymized data for their internal decision making. These technologies can also be used to improve user support for the solution.

The final theme emerging from the responses is technology modernization. Modernizing activities include cloud transition to allow scaling, performance, cost minimization and ensuring security; data encryption for data in the cloud; and architecture change / refactoring to modern, more flexible approaches such as microservices. However, answers also show that vendors that already have a modernized solution are planning to focus their development efforts on these new solutions, with the expectation that these will replace the legacy solutions still used by their customers over time.

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3. Overview of market changes

In the wake of the COVID-19 pandemic, health has been a focused area globally. Many healthcare providers have resumed the process of looking at solutions that will enable clinical digital transformation with an increased focus on digital patient engagement. Driven by policy making at National and European level, interoperability for health data within systems, both nationally and across borders, is especially prioritized. There has been an observed increase in activity level on EHR adoption and implementation consequently. This chapter outlines the market changes in the EHR market globally, in Europe and in Norway.

3.1. Development of the Global EHR market

The pandemic has accelerated healthcare providers adoption of EHR, but there are several other factors driving the market changes that have been observed.

1. Regulatory changes and market pressures

It has been historically complex to enable data sharing between EHR solutions, thus actions have been taken globally to deliver greater healthcare interoperability and to realize the full value of the EHR. For example, the U.S. Government set, in 2021, the first compliance deadlines for the U.S. Office of the National Coordinator for Health Information Technology's (ONC's) interoperability and information blocking rule and this is now in that went into effect. These regulations mandate the adoption of standardized APIs based on the FHIR standards and prohibit "information blocking" practices by healthcare IT developers and providers. And, in the U.K., the NHSX Digital Technology Assessment Criteria (NHSX merged into NHS England in 2022) includes baseline interoperability requirements for digital health technologies. (G00742367, December, 2021)

For Europe, the EU Commission presented proposals for a regulation to set up the European Health Data Space (EHDS). The EHDS is a "health-specific data sharing framework establishing clear rules, common standards and practices, infrastructures and a governance framework". The objective is to enable data sharing across the borders and secure access to the health data for the population, while encouraging use of the health data for research, innovation and policy making purposes. (European Commission, 2022)

2. Changes in customer needs

The healthcare providers continue to strive to maximize the benefits and value from their EHR solutions to improve the clinician experience through AI, big data and analytics, patient engagement, clinical outcomes, and the shift to value-based care. In response, the vendors are evolving their solutions by introducing new capabilities or maturing existing ones to remain competitive and support these improvements. (G00742367, December, 2021)

3. Increased patient focus

There is an increased focus on digital patient engagement and empowerment, with a growing adoption of telemedicine and remote monitoring.

These multiple forces are behind the key developments that have been observed in the global EHR market:

- EHR procurement activity is gathering momentum

- Vendor consolidation through mergers and acquisitions

- Multinational EHR suites are gaining a foothold in the Nordic Market

- Increased governmental and customer interest in openEHR (especially in the Nordics)

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- Growing number of EHRs in specialized care

- Increased demand for EHR with cloud capabilities

- Increased focus on usability through Smart EHR UI and advanced analytics

- Emergence of Digital Health Platforms (DHP) and industry standards such as HL7 and FHIR for health data integration.

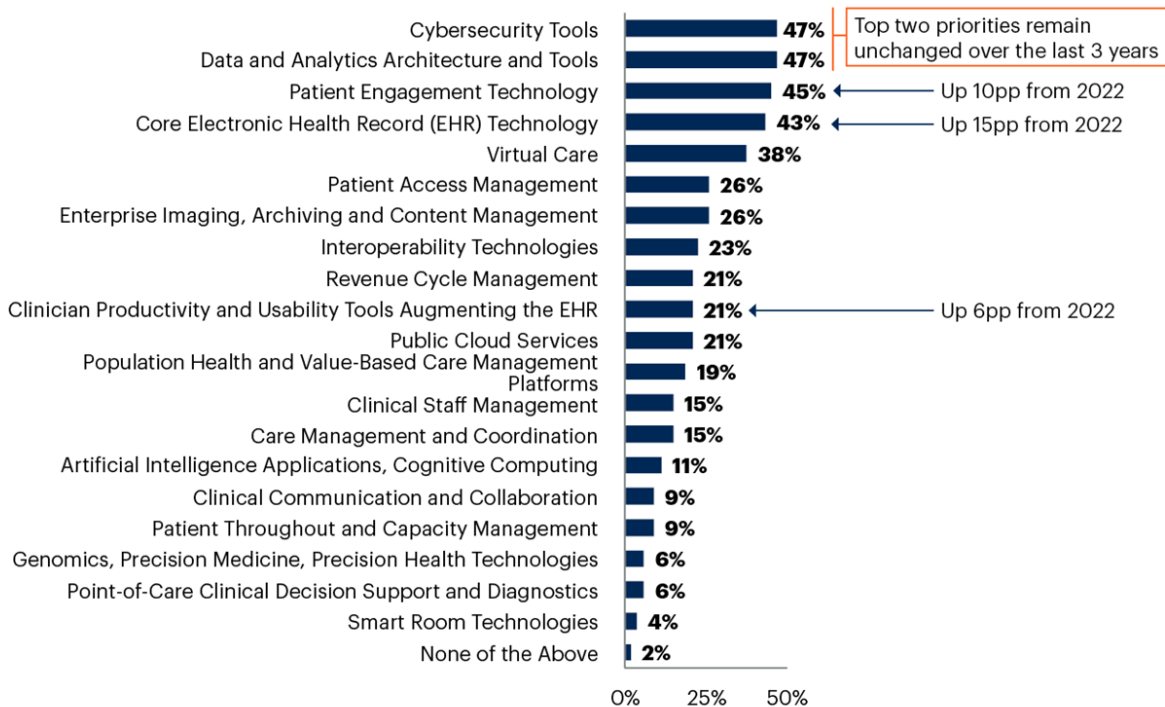### 3.1.1. EHR procurement activity is gathering momentum

There has been observed a high activity level of EHR procurements globally after the pandemic. The activity level is varies from region to region, as some countries and regions in the market are moving into saturation and consolidation stage (for example, the U.S.), whereas in others (for example Australia, Europe, Latin America, and the Middle East), EHRs are being implemented for the first time. The developments in the less mature markets are driven by regulatory changes and market pressures to solve interoperability challenges. (G00742367, December, 2021)

Many EHR systems have challenges with information and data sharing as some are developed with a relatively closed data architecture which affects the interoperability with other systems. It is consequently challenging to create a complete patient health record, share information between the different healthcare providers and use the data for population health and research purposes. The contract with EHR vendors is often accompanied by complex terms and conditions covering how data access and required data exchange can be achieved at scale. (G00742367, December, 2021) The regulatory measures that have been taken in several of the regions, such as the NHSX Digital Technology Assessment Criteria in the UK and the regulation proposal EHDS in Europe, will hopefully address these barriers.

In addition, Gartner's CIO and Technology Executive Survey (Figure 31) shows an increase in 2023 investment priority towards EHR and adjacent solutions even post pandemic. The planned investments towards the core EHR technologies alone have increased 15 percentage points from 2022, followed increased planned investments into patient engagement technology and clinician productivity and usability tools augmenting the EHR. (G00778268, December, 2022)

Figure 31. Global healthcare provider priorities for increased investment in 2023 (G00778268, December, 2022)

Healthcare Provider Priorities for Increased Investment in 2023
Percentage of Healthcare Provider Respondents

Priority	%
Cybersecurity Tools	47%
Data and Analytics Architecture and Tools	47%
Patient Engagement Technology	45%
Core Electronic Health Record (EHR) Technology	43%
Virtual Care	38%
Patient Access Management	26%
Enterprise Imaging, Archiving and Content Management	26%
Interoperability Technologies	23%
Revenue Cycle Management	21%
Clinician Productivity and Usability Tools Augmenting the EHR	21%
Public Cloud Services	21%
Population Health and Value-Based Care Management Platforms	19%
Clinical Staff Management	15%
Care Management and Coordination	15%
Artificial Intelligence Applications, Cognitive Computing	11%
Clinical Communication and Collaboration	9%
Patient Throughout and Capacity Management	9%
Genomics, Precision Medicine, Precision Health Technologies	6%
Point-of-Care Clinical Decision Support and Diagnostics	6%
Smart Room Technologies	4%
None of the Above	2%

Top two priorities remain unchanged over the last 3 years

Patient Engagement Technology — Up 10pp from 2022
Core Electronic Health Record (EHR) Technology — Up 15pp from 2022
Clinician Productivity and Usability Tools Augmenting the EHR — Up 6pp from 2022

n = 53 healthcare provider CIOs and technology executives answering

Q. Please select the top five provider-industry-specific solutions that your enterprise will spend the highest amount of new or additional funding on in 2023.
Source: 2023 Gartner CIO and Technology Executive Survey
Note: pp = percentage points
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3.1.2. Vendor consolidation through merger and acquisition

Merger and acquisition activities have been observed in the EHR market on a global basis. Some of the drivers behind these activities are a desire to gain market share in the healthcare vertical or in another user segment within healthcare. One example demonstrating this is Oracle's acquisition of Cerner.

With the global megasuites entering markets outside of the U.S., challenging the local EHR market, there have been cases where the smaller local vendors are looking to consolidate to gain a competitive edge. In the U.K., there are ongoing discussions regarding this topic. Meanwhile, a similar development has occurred in Norway already. A new e-health and technology company has emerged and acquired established EHR vendors, in addition to start-ups, with the aim of penetrating different user segments within healthcare in Norway.

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3.1.3. Multi-national EHR suites are gaining a foothold in the Nordic market

Global EHR megasuites are seen competing with regional and local vendors in the Nordic countries. For example, Oracle Cerner and Epic Systems have a large presence in Norway. Epic Systems landed a sizeable contract covering the whole regional of Mid-Norway (Helse Midt-Norge) through Helseplattformen AS with 40.000 potential users. (Trondheim kommune, 2023) Other examples include the Apotti Project in Finland (Epic), and Västra Götalandsregionen (VGR) and Region Skåne, two of the largest healthcare regions in Sweden (Oracle Cerner).

Healthcare providers adopting global solutions in regions outside of their primary market encounter three key challenges:

1. *Limitations in functionality* — For example, capabilities such as revenue cycle management, APIs and population health management may only be available in the vendor's primary market.

2. *Localization of solutions to regional requirements* — For example, language, terminology, billing, legislative and reporting have proven problematic for global EHR vendors.

3. *Prioritization of development of new capabilities* — Regional requests for new capabilities may not be prioritized if not aligned to the primary market or broad customer base.

Whilst the global vendors have the scale and experience, the regional and local vendors value proposition hinges on their ability to deliver an EHR solution that is fit-for-purpose in the local market. In addition, having local vendor support can be a benefit and the TCO of regional and local solutions are often significantly lower than the global megasuites' EHR. (G00742367, December, 2021)

3.1.4. Increased interest in openEHR

OpenEHR presents a disruptive trend within the EHR market space that challenges traditional closed monolithic products. It is an open-source initiative to improve the management of electronic health records (EHRs) and is based on the idea of separating the management of EHR data from the applications that use that data. This allows for the creation of EHR systems that can be easily customized and integrated with other systems and technologies.

OpenEHR aims to provide both intraoperability and interoperability within the EHR space. Interoperability refers to the ability of different systems to exchange and use data, while intraoperability refers to the ability of different systems within a platform to work together seamlessly. OpenEHR's approach emphasizes intraoperability, but it does not exclude interoperability. By focusing on compatibility between systems within a platform, OpenEHR can improve interoperability between different EHR systems by creating a common framework for data exchange. This can ultimately lead to more efficient and effective healthcare delivery by reducing the fragmentation of patient data and improving the continuity of care.

To support that, openEHR is based on an open specification of a health information model. The EHR data is described in an open, fine grained, structured format which is vendor and technology neutral (a harmonized data model). In addition, openEHR supports content-based queries, such as information model querying, independent of the actual database querying. Thus, openEHR provides a way to query EHR data based on the content of the data itself, rather than relying solely on querying the underlying database. This is made possible by the openEHR specifications, which define a common information model for representing clinical data in a standard way (archetypes). Because the data is stored in a standardized format, it can be queried using a content-based approach, which allows for more flexible and powerful

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queries than traditional database queries. This approach also promotes interoperability between different EHR systems, as they can all use the same information model to represent and query clinical data. In an openEHR implementation, a common clinical data repository is shared for storing openEHR data (open platform).

General benefits of openEHR could include:

- Cross-organizational customer paths

- Optimization of customer paths instead of optimizing the operations of individual organizations

- Data sharing across organizations and different systems

- Utilization of decision support and automation in cross-organizational customer paths

- Population level analytics

- The ability to introduce new innovations in an agile way

- The ability of users to select best-of-breed functionalities for different purposes

- System changes can and will need to be managed in a controlled and agile way

OpenEHR is positioned to be a key enabler for open ecosystems within healthcare by allowing an innovative vendor ecosystem to be built in an agile way: semantically interoperable applications connecting to the openEHR platform via standard APIs. This will enable:

- Innovative ways to utilize data

- Access to a population level universe of data (with appropriate security controls in place)

The openEHR platform includes several different components, including a data model, a reference architecture, and a set of open-source software tools. The data model defines the structure and format of EHR data, while the reference architecture provides a framework for the design and implementation of EHR systems. The open-source software tools provide developers with the necessary tools to create and implement EHR systems based on the openEHR platform.

The openEHR is a fast-growing market, with several European hot spots, such as UK, Norway, Sweden, Finland, the Netherlands, Spain, Italy, Slovenia and Germany. The UK is the most mature market in Europe regarding openEHR with their integrated care agenda as the driver. The Christie NHS Foundation Trust is one of the initiatives in the UK using openEHR through the Better Platform (openEHR, 2022).

Although openEHR is of high interest in Europe, openEHR is not strong on the U.S. radar. This is presumably due to the market dynamics in the U.S., where Oracle Cerner and Epic remain dominant players in the market. Together, they now hold more than 50% of the acute care market in the U.S, with Epic increasingly becoming the preferred system for the large healthcare providers (G00742367, December, 2021). The U.S. based global megasuites will most likely not convert their data model to openEHR, as it will likely demand high investment to align their EHR portfolio.

While the megasuites vendors are cautious with respect to openEHR, smaller European and Nordics EHR vendors are utilizing the opportunity to use it as a competitive differentiator. Both Sweden and Norway can be considered frontrunners in openEHR adoption (as seen in Figure 32 below) with companies such as Cambio, DIPS and PatientSky undertaking openEHR projects to convert their data model to align with openEHR (Pohjonen, 2022). In both Norway and Sweden there are national data sharing initiatives in place; cross enterprise document sharing (XDS) is also used, but in Sweden for imaging only (XDS is a set of standards and specifications that enable the secure sharing and exchange of clinical documents between different EHR systems and healthcare organizations). Additionally, Norway is active nationally

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in openEHR definition work through Norwegian Clinical Knowledge Management (CKM) as a part of an intra-region collaboration (Direktoratet for e-helse, 2018). In Sweden there is ongoing academic work regarding openEHR modelling and openEHR extracts to be used for national data sharing. Region Östergötland is leading the archetype work without national steering. Furthermore, Finland is conducting a pilot for national openEHR based UNA Core for data exchange. A number of Danish hospitals and healthcare organizations have also been exploring the use of openEHR as a way to improve data interoperability, data quality, and clinical decision-making.

Figure 32. Maturity Level of openEHR in Nordics (Gartner analysis)

Maturity level of openEHR in Nordics
Scale: 0 (low maturity) - 7 (very high maturity)
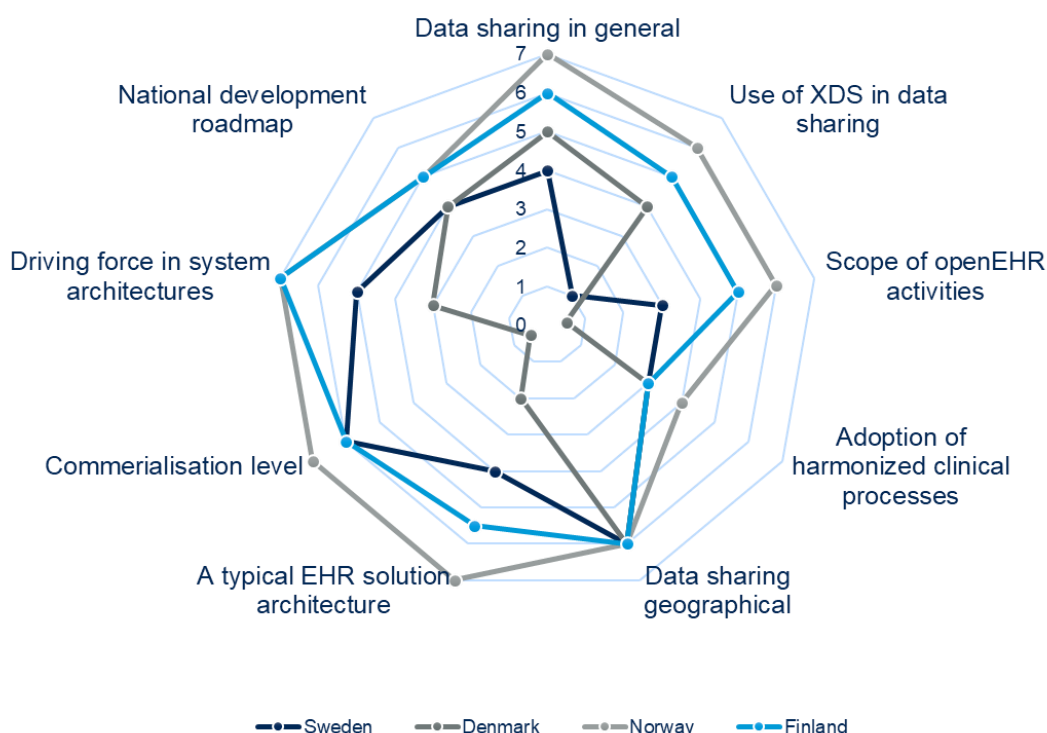
3.1.5. Increased demand for EHR with cloud capabilities

The total cost of ownership (TCO) is one of the drivers for the increased movement from on-premises solutions to cloud-based solutions. Many healthcare providers have traditionally struggled to demonstrate quantifiable return on investment associated with their EHR investments. Where they do, the time to achieve this return is measured in years — not weeks or months. This is due not only to the significant initial capital investment in licensing and implementation, but also ongoing costs related to support, optimization, and upgrades. (G00742367, December, 2021)

Gartner ITKMD analysis shows increasing investments globally towards SaaS and cloud-based solutions among the global healthcare providers as shown in Figure 33. (G00779707, December, 2022)

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Figure 33. Healthcare Providers IT Spending in the SaaS and Cloud (G00779707, December 2022)

IT Spending by Asset Category
Healthcare Providers

Year	Software (SaaS)	IaaS and Other Public Cloud	Software (On-Premise)	Hardware	Personnel Salaries & Benefits	Network Transport	Traditional Outsourcing
2018*	6%	2%	26%	13%	39%		14%
2019*	7%	3%	26%	14%	38%		12%
2020**	9%	2%	22%	15%	41%	5%	5%
2021	10%	3%	23%	14%	35%	8%	7%
2022	10%	5%	20%	15%	35%	7%	8%

Source: Gartner (2022)
Note: Totals may not equal 100% due to rounding.
2018*/2019* - SaaS category introduced. Outsourcing category includes Network Transport
2020** - Network Transport category introduced, Outsourcing category includes only traditional outsourcing services
ID: 779707

While there is a lack of truly flexible, scalable SaaS models across enterprise EHR vendors, many vendors are attempting to address unwieldy TCO and value realization challenges by:

- Moving to web-based application architectures.

- Offering "cloud"-type hosted and managed application services.

- Adopting more agile development and deployment practices.

- Increasing capacity to deliver new functionality to clients through reduced release cycle times.

- Leveraging digital platforms offered by digital giants (such as Salesforce, Microsoft, Amazon Web Services (AWS) and Google) to boost scalability, reduce cost and expand features beyond their core offerings.

For the healthcare providers, newer cloud-based solutions mean that they can utilize technologies in ways that can enable faster, improved patient care and reduce clinical documentation burden. For example, cloud-based solutions may provide functionality such as NLP-enabled voice technologies to improve the EHR user experience or support mobile GPs and reduce EHR-associated physician issues allowing access to the EHR wherever they are, from any workstation or mobile device. (G00738871, January, 2021)

3.1.6. Increased focus on usability through Smart EHR UI and advanced analytics

EHRs have consistently performed poorly on usability measures. In a study from 2017-2018, researchers surveyed U.S. physicians across all specialty disciplines measuring EHR usability using system usability scales (Edward R. Melnick, 2020). The scores in the survey were in the bottom 9% of scores across studies in other industries and falls into the category of "not acceptable", which clearly indicates how poorly the usability was perceived. (G00738871, January, 2021).

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Poor EHR usability is strongly associated with clinician burnout, which is a prevalent and serious problem for healthcare provider organizations. Clinician burnout has been exacerbated by pandemic conditions and has suffered from and contributed to unprecedented healthcare workforce shortages. Minimizing the burden on the care team and preventing further attrition or out-migration from the industry is a top priority in most healthcare provider organizations (G00768917, July, 2022).

As a response, there are several digital innovations and market solutions for optimizing and transforming healthcare provider delivery capabilities by increasing EHR usability, such as Smart EHR user interface (UI), voice-technologies in EHR and EHR support of virtual care. This is reflected in Gartner's Hype Cycle for EHRs and related technologies 2022 (Figure 34).

Figure 34. Custom Hype Cycle for EHRs and related technologies 2022
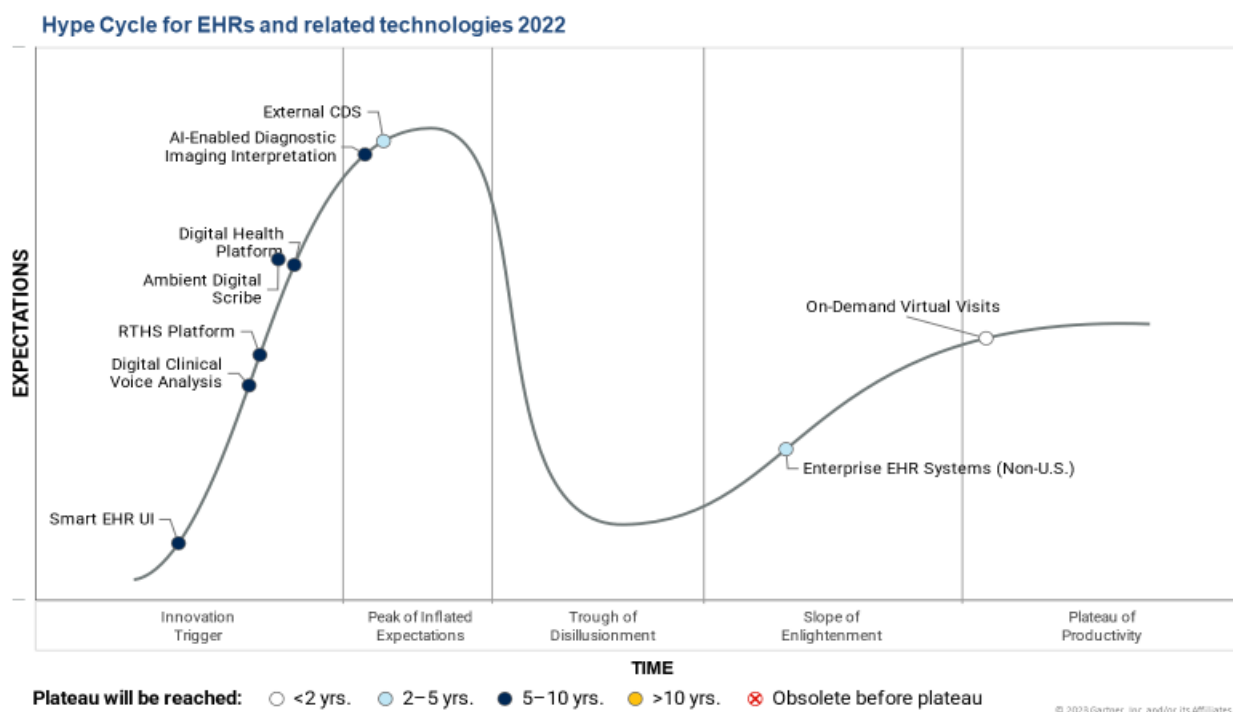
Smart EHR UI

Smart EHR UI solutions use AI and ML to synthesize, summarize and elevate relevant clinical data from the EHR and other clinical data sources, creating a contextualized view of the patient record. These solutions are integrated within the primary EHR UI, providing a seamless experience to the clinicians and end-users. Through smart EHR UI solutions, the healthcare providers can improve usability and mitigate clinician burnout by reducing the time and effort to find relevant clinical information within the EHR. (G00768917, July, 2022).

Gartner expects increased adoption of smart EHR UI solutions to solve the growing complexity and volume of clinical data. As EHR adoption continues to grow and interoperability initiatives accelerate, the volume and complexity of clinical data that clinicians must navigate will become increasingly challenging. EHR data is usually organized chronologically in complex and non-standard hierarchies and is presented without consideration for clinical relevance or context. (G00768917, July, 2022).

Through the deployment of smart EHR UI solutions, healthcare providers will:

- Increase clinician productivity and capacity by reducing time spent on chart review and searching for relevant clinical data.

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- Improve the total experience of patients and clinicians by maximizing the patient-clinician interaction, whether conducted virtually or in person.

- Enable clinicians to make more informed decisions and reduce errors of omission by elevating relevant data that might otherwise be overlooked.

Smart EHR UI solutions offer healthcare provider organizations a way to improve EHR usability without significant time or resource requirements from internal IT departments or EHR vendors. These solutions integrate with EHRs primarily through FHIR APIs, resulting in shorter implementation timelines and minimal integration costs. The adoption of FHIR interoperability standards is lowering the bar for vendors seeking to integrate with EHRs. (G00768917, July, 2022).

It is worth noting that smart EHR UI solutions are primarily designed to support view-only workflows. These solutions can identify and elevate relevant clinical data from a disparate EHR or system without robust write-back capabilities, but that data may not be actionable. This may result in perpetuation of an incomplete patient record and disjointed clinical workflows. There is also a lack of industry standards for developing and validating AI- and ML-enabled solutions and concerns over opacity and legal liability are slowing adoption into clinical practice (G00768917, July, 2022).

Voice-technologies in EHR

Advances in NLP-enabled voice technologies are providing new opportunities to improve the electronic health record (EHR) user experience and reduce EHR-associated physician burnout, and digital documentation solutions are currently evolving at pace, from digital transcription to digital scribes to ambient digital scribes (Figure 35). Two clear use cases for enabling the EHR through voice technologies are emerging — to automate the clinical documentation process and to replace the keyboard and mouse with a conversational user interface in the form of a virtual assistant.

Figure 35. Ambient Digital Scribe are designed to automate the clinical documentation process associated with a clinical encounter

Ambient Digital Scribe
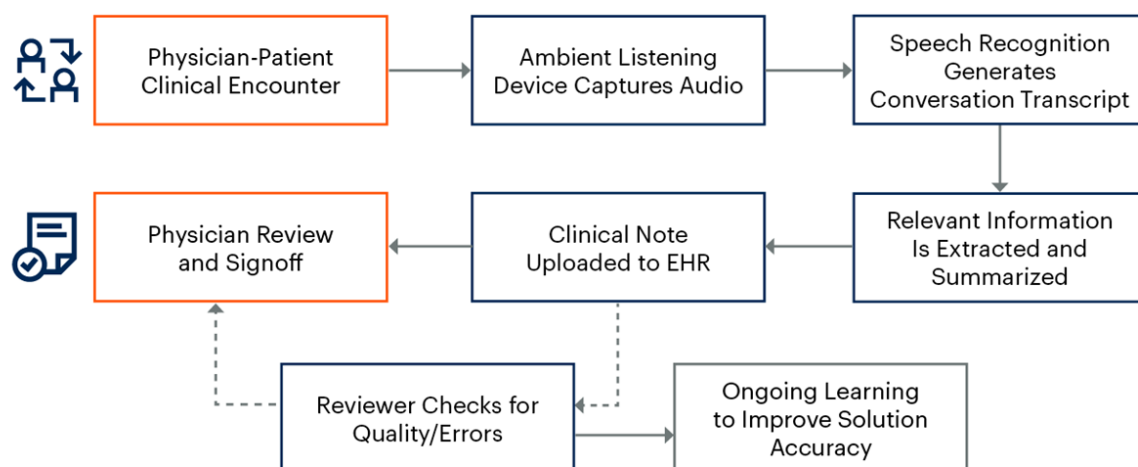
Source: Gartner
738871_C

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The voice-technology solutions available on the market are provided by a mix of vendors, mainly in the U.S. These include established vendors with mature NLP capabilities, startups with new and innovative approaches and EHR vendors offering either natively built capabilities or capabilities provided through strategic partnerships with other vendors. It is expected that the adoption of digital scribes and ambient digital scribes will become available in other English-speaking countries, and longer still for geographies where English is not the native language. Mainstream adoption is some five to 10 years away (G00738871, January, 2021).

EHR support of virtual care

Healthcare organizations are re-evaluating their portfolio of virtual services and enabling technologies. They aim to provide improved and expanded virtual care services to their patients and pursue more complex models of virtual care delivery, such as hospital-at-home and remote patient monitoring (RPM) for chronic conditions. Healthcare CIOs face strategic decisions on what digital capabilities they need to sustain and expand to scale virtual care services.

This can be done through EHR that support virtual care with a set of capabilities integral to a core EHR product suite that enables the remote delivery of care when the clinician and patient are not co-located. These interactions include both asynchronous and synchronous virtual visits, as well as RPM. (G00768917, July, 2022)

Healthcare providers are rationalizing their virtual care solution portfolios and prioritizing investment in solutions that will allow them to sustain and scale their virtual care services as these are viewed as important new sources of revenue. Improving both patient and provider experiences is a key requirement for increasing the adoption of these solutions and services. This requires tight integration with EHRs to streamline clinician workflows, ensure continuity of care, and offer patients a seamless experience across digital and in-person care modalities. (G00768917, July, 2022)

However, improving both patient and provider experiences is a key requirement for increasing the adoption of these solutions and services. This requires tight integration with EHRs to streamline clinician workflows, ensure continuity of care, and offer patients a seamless experience across digital and in-person care modalities. At the same time, clinicians will actively resist a shift to virtual care delivery when the administrative burden of using the EHR and virtual care technology (e.g., disjointed systems and duplicative documentation) outweighs that of face-to-face care. (G00768917, July, 2022)

3.1.7. Emergence of digital health platforms

Digital Health Platforms (DHP) is an architectural approach where health solutions connect via data exchange and form an ecosystem (G00752852, October 2021). that enables healthcare providers to rapidly respond to business changes using cloud solutions. This will result in a more adaptable and efficient IT portfolio in addition to addressing limitations with existing monolithic EHR-centric application architectures that cannot meet changing patient, consumer and clinical workforce demands. These platforms will not necessarily replace EHRs, but EHRs will be a key component in the ecosystem as shown in Figure 36 below. (G00768917, July, 2022)

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Figure 36. Digital care delivery ecosystem (Gartner)
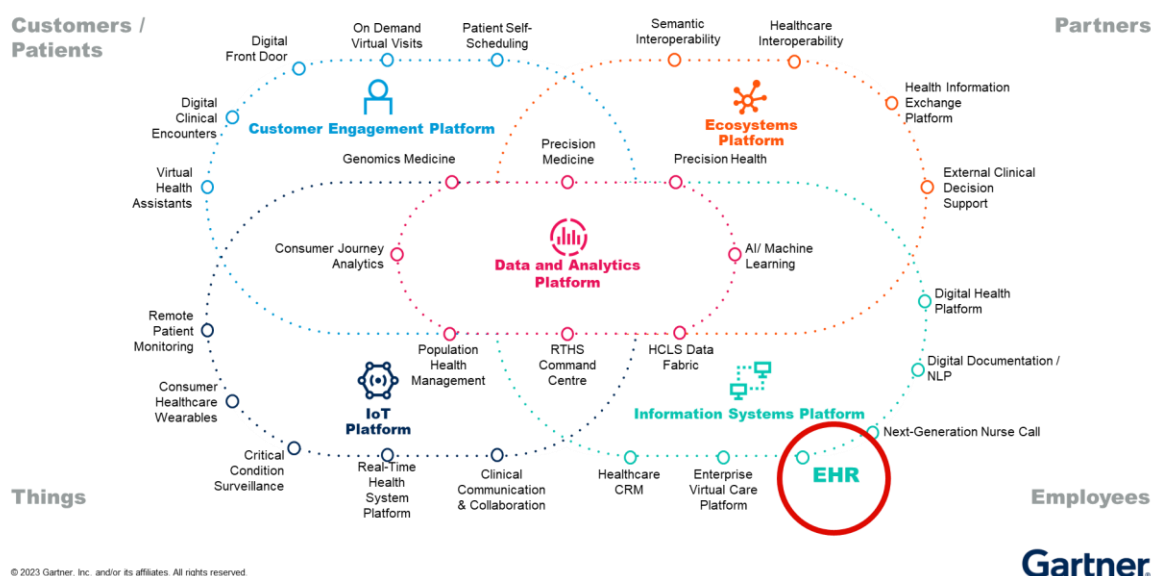
Through the DHP, healthcare organizations want the ability to (G00774741, August, 2022):

- Build and scale new digital capabilities from their existing monolithic IT estate, which they cannot easily replace, by liberating siloed data

- Create positive digital experiences for clinicians to address poor physician satisfaction, a significant contributor to burnout, and enable them to spend more time with patients.

- Provide the orchestration and information needed to support an integrated health and care ecosystem, including public health, payers, and social care

- Innovate while facing cost and resourcing pressures — deliver more with less.

The DHP will enable this through increased resilience, adaptability, and flexibility for organizational imperatives. Additionally, DHP can help address business capability gaps through repurposing data or application functionality in existing IT investments and reduce reliance on vendors that lock-in buyers. (G00768917, July, 2022)

3.2. Past developments of the Norwegian EHR market

Almost a decade ago, in 2014, Gartner conducted a market survey of the EHR on behalf of the Norwegian Directorate of Health (Helsedirektoratet). The responses received within this report demonstrate that, since then, the Norwegian EHR market has undergone several major changes.

In 2014, Global EHR products had not yet penetrated the Nordic Market, although other product offerings from the Global megasuites were implemented in the Nordics. The EHR products from Global EHR vendors were more functionally mature than locally based regional vendors, especially within core capabilities such as Clinical Decision Support, Clinical Workflow and Clinical Display/dashboards. The Norwegian EHR market was in 2014 very focused on local Norwegian products, which implied that local understanding and references, as well as proximity, were prioritized over functionality when vendors were chosen. This meant that the majority of the Norwegian hospitals at that time did not get the benefit of the global best practices supported by the Global megasuites. There were a small number of bigger,

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local EHR vendors that dominated the EHR market. The market view has now somewhat shifted towards an increasing number of solutions that are available for hospitals, community care and GPs. In 2023, Global EHR megasuites have now entered the Norwegian EHR market and one of the megasuites has signed a sizeable contract covering the whole mid-region of Norway. The Norwegian EHR vendor market has also expanded with new entrants – there are seven new vendors and eight new EHR products in the market since the last survey in 2014. Where previously only a few vendors dominated the market, this is now true to a lesser degree.

Compared to 2014, the EHR products from the local Norwegian vendors are now considered fundamentally mature, as the majority of the EHR products within the market can deliver both the fundamental and additional capabilities to healthcare organizations. In addition, a move from on-premises solutions to cloud-based solutions in Norway has been observed. Over 50% of the EHR vendors in Norway have cloud-based delivery models as part of their product offering, and all eight of the new EHR products that have been launched since 2014 are cloud hosted.

Norway is one of the most mature markets in openEHR adoption and is one of the front-runners contributing to the standards definition work through the participation of the Clinical Knowledge Management (CKM) organization as part of an intra-regional collaboration between the four Norwegian health regions: Helse Nord, Helse Midt-Norge, Helse Vest and Helse Sør-Øst (Helse Vest IKT , 2021; Pohjonen, 2022; Helse Vest IKT, u.d.). Additionally, two of the Norwegian EHR vendors have already converted their data model to openEHR.

3.3. Observations of the changes in the vendor market in Norway

This chapter outlines the observations in the vendor market in Norway from three perspectives: changes driven by national guidelines, changes driven by vendor developments and changes driven by evolving user needs.

3.3.1. Developments driven by national guidelines

Leveraging the full value of EHR solutions will be a key approach in enabling a sustainable healthcare in Norway with higher quality, interoperability, increased patient safety and collaboration between the healthcare organizations all being benefits. As such, national guidelines and strategic documents are being developed to stimulate the realization of this value. These include:

- The national health and collaboration plan for 2024-2027 (Nasjonal helse- og samhandlingsplan/NHSP)

- The national e-health strategy

- The Helseteknologiordningen

The developments of standards and professional guidelines for increased interoperability of the systems (such as FHIR, SMART-on-FHIR, SNOMED CT and openEHR) are one of the main government focus areas in Norway at present. The findings in this report also show that this is also a focus for the majority of the EHR vendors. Helseteknologiordningen is a program aimed at supporting the quality of the municipalities healthcare services provided to citizens by contributing to sustainability of the healthcare system. Furthermore, Helseteknologiordningen is also an initiative where the development of standards will be a central element. The program provides knowledge about standardization and norms, and guidance to help ensure that municipalities and suppliers have clear requirements and frameworks with which to comply.

Improved healthcare interoperability will enable more seamless and better patient care, and therefore is an area that several national strategies are addressing. Major government policy

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documents such as "Én innbygger – én journal" and the national health and collaboration plan for 2024-2027 are pointing to the importance of interoperability. As part of the development of the "Én innbygger – én journal", which was proposed for the entire country, the health region Helse Midt-Norge is piloting one journal per citizen for the whole region through Helseplattformen, an EHR provider owned by Helse Midt-Norge RHF (health region for specialized health care) and several municipalities.

There are, at present, few regulation-driven EHR changes, but the new regulation proposal EHDS from the EU Commission might be an exception if approved. Although Norway is not a part of the European Union, the country is a member of the European Economic Area (EEA) and needs to follow the regulations that are marked as relevant for EEA, and this includes the new EHDS regulation. The EHDS' objective is to enable data sharing across the borders and secure access to health data, and the Norwegian directorate of e-health is currently analyzing the potential consequences and what EHDS means for Norway as a whole. (Direktoratet for e-helse, 2022)

3.3.2. Changes driven by vendor developments

Modernization and adoption of new technologies is happening in a similar across vendor sizes and geographic footprints, according to our findings. These changes can also be observed in Norway. The following are some key technology developments:

- *Improvements in clinician experiences* and efficiency of using EHR solutions through intelligent scanning of paper documents. Although NLP and digital transcribing are not common in Norway now, these technologies are on the vendors' radar

- *Leveraging AI and ML technologies* to automate administrative tasks, increase patient safety (for example precision dosing for drugs), personalized patient experience, population studies and clinician decision support

- *Increased focus on technologies to provide near real-time data* and analytics for insights for care and patient safety

- *Increased use of general data handling capabilities* such as business intelligence tools, with plans to add reporting capabilities and connect EHRs with pre-existing BI solutions

- *Increased use of standards to enable interoperability* for data sharing between systems and other sources such as medical devices and sensors

- *Transition towards the cloud* enabling benefits such as scaling, performance, cost efficiency and ensuring security; ensuring encryption for data in the cloud; and transition towards microservices architectures to increase flexibility.

Although the vendors are responding to emerging user needs and regulations, there are still functional capabilities that lack support in current EHR solutions. Examples include:

- Capabilities related to clinical functionality (clinical decision support and especially advanced clinical decision support; advanced clinical workflow; and clinical displays).

- Capabilities supporting better leveraging of data (clinical research and RWE; advanced reporting and analytics).

- Some capabilities that are specific to specialized care use cases.

In addition to technological advancements in the Norwegian EHR market, there is also an interesting development where a new e-health and technology company has been set up and has acquired well-established EHR vendors and other start-ups, with the aim of penetrating different user segments within the healthcare sector in Norway.

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3.3.3. Changes driven by developing user needs

The user needs in the healthcare sector have changed, driven by a requirement to improve the clinician experience, mitigate clinician burnout and increase workforce capacity. In response, there are several digital innovations and market solutions to improve healthcare provider care delivery by increasing EHR usability. Examples include:

- *Clinical display/dashboard capabilities* in the EHRs to present the data for clinicians in a meaningful manner that allows them to use the data effectively.

- *NLP-enabled voice technologies* to improve the clinician experience and patient safety through voice and ambient listening, although ambient digital scribes and digital scribes are not widely available in Norway yet.

- *EHR support of virtual care* though a set of capabilities integral to a core EHR product suite that enables the remote delivery of care when the clinician and patient are not co-located.

3.4. Strengths and Cautions of the Norwegian EHR market

As seen in the previous chapters, many trends Gartner observes within the Global EHR market also apply to the market in Norway.

This section summarizes the strengths and cautions facing the Norwegian EHR market. The strengths and cautions are based on responses provided by the vendors, Gartner's observations in the other Nordic countries and global trends impacting the EHR solutions.

3.4.1. Strengths

This report has identified four distinct strengths of the Norwegian EHR market:

- *Multiple vendors and new emerging ones*

- *Mature electronic healthcare market*

- *Landscape to support emerging digital health platforms*

- *Government involves vendors actively when developing major policies and standards*

There are multiple vendors present in the market offering solutions to varying user needs. Previously, the market was clearly dominated by certain vendors, but new vendors have entered the market to particularly serve primary care users. These vendors have tailored their solutions to enable flexible, location independent use and to provide a consistent clinician experience. These solutions either replace or complement existing legacy products used by these organizations. In addition, vendors dominant in specialized care and serving both specialized and primary care, have launched new products built on modern technologies and architectures that allow a greater level of use.

Norway is a mature market in electronic healthcare. The use of electronic patient records is widespread and national level consolidation of health data, particularly through the Helsenorge platform, is the norm. Helsenorge enables patients to access their medical records, summary care records and electronic prescriptions from hospitals across the country (with the exception of the Midt-Norge region). The vendor responses to this survey show that vendors present in the market have focused on interoperability between their EHR solutions and the central data sources:

- *The Summary Care Record (*Kjernejournal) is a collection of essential health data from local and regional Electronic Health Records (EHRs) in Norway. This record provides healthcare professionals with fast access to critical health information about a patient, regardless of their treatment provider. The SCR can be accessed through Helsenorge.no, but it is primarily accessed through the EHR. However, it is important

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to note that the SCR does not replace patient records from General Practitioners or hospitals. At present, there are no plans to allow access to patient records from GPs through the SCR. Some clinicians may also access the SCR through a web-based portal. Patient records from hospitals are gradually being made available through the SCR.

- *The "Pasientjournal" service at helsenorge.no*provides access for patients to read their patient records in hospitals, by using a document sharing service (XDS). This service is only available for patients in the following hospital regions: Helse Nord, Helse Sør-Øst and Helse Vest. Helse Midt-Norge presents hospital patient records on a separate platform called HelsaMi, that will in addition, be integrated with Helsenorge. Patient records from the GP or other parts of the healthcare system are not yet provided on Helsenorge.no.

- *The Electronic prescriptions (e-resepter)* service shows a summary of a patient's prescriptions.

The healthcare market has matured in terms of allowing various systems and applications to integrate with each other to create a connected ecosystem around *healthcare delivery.* For example, Norway is, among the Nordic countries, perceived to be mature in its efforts to embrace openEHR's architectural guidelines (to support integration of EHR solutions with multiple other systems and applications within the health data space). Vendor responses show that many vendors are looking to invest further development efforts into international standards and design guidelines such as openEHR.

Finally, the Norwegian Government actively engages in dialogue with vendors to obtain their input when developing major policies and standards. This allows the Norwegian authorities to gain up-to-date knowledge about the status and plans for the use of national e-health solutions and a market perspective on EHR solutions. The Norwegian authorities also learn about strategic aspects, functional elements and interaction capabilities to allow strategy development based on information directly from the suppliers. Furthermore, the authorities can facilitate a market dialogue between vendors offering new capabilities and enhancements, and the user organizations, to identify the priorities for meeting the evolving needs of digital healthcare.

3.4.2. Cautions

Based on the information received from the vendors, expert discussions around the market space as well as observations in the Nordic and Global markets for EHR solutions, five cautionary areas are identified as especially relevant for Norway:

- *Perceived lack of capability for certain user groups or use cases*

- *Complexity related to renewing EHR solutions*

- *Varying levels of users' and health delivery organizations' knowledge of the existing capabilities*

- *Language challenges when using EHR products from non-local vendors*

- *High number of on-premises solutions still in use that vendors potentially are looking to replace*

- *Maintaining a sustainable rich ecosystem to support innovation in digital health*

There is a lack of capability coverage for certain user groups or use cases especially in the primary care sector where users have the perception that the current solutions do not meet the particular needs of the users. Most importantly, the EHRs in use do not fully support information exchange between the systems. (Felles kommunal journal interim AS, 2022) The scope of this report is based on vendor responses and hence it has not been possible to

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assess how well the EHR products provide clinicians with the support they need in terms of required capabilities in practice.

According to previous reports, most municipalities use several different EHRs, many of which are based on outdated technology and architecture. The deployment of improvements to these solutions is slow, and many municipalities take a significant amount of time to upgrade to the latest EHR version. Many municipalities may even postpone upgrading altogether. (Felles kommunal journal interim AS, 2022) In addition, health delivery organizations face challenges when renewing their solutions, such as access to expertise and resources, demanding change and readjustment processes, insufficient business case planning, and other barriers to investment (Direktoratet for e-helse, 2022). The amount of work needed for renewing EHR solutions is heavily driven by both use case and organizational complexity. The responses received for this report show that some solutions aim to provide low barriers for adoption, whereas other provide additional options such as consulting services, implementation, and configuration support to assist with this.

The knowledge that health delivery organizations and users have about the existing capabilities can be another factor explaining user dissatisfaction about how the current EHR solutions support them, especially within the primary care area. Earlier reports show that not all municipalities have adequate access to expertise in managing requirements and utilizing guidelines to ensure EHR solutions are appropriately configured. Moreover, municipalities may lack resources or dedicated staff to carry out complicated procurements. (Direktoratet for e-helse, 2022) Based on the responses received for this report, vendors, regardless of size or geographic footprint, typically have a structured approach to provide training for users as the solutions develop. The lack of knowledge is an opportunity both for the vendors to better outline the capabilities and benefits of their solutions and for the users and the organizations they represent to engage more actively in the knowledge sharing with their current vendors even after the initial investment decision.

Using EHR products from global megasuite vendors or other non-local vendors, *language barriers* can be yet another factor that explains user dissatisfaction with usability and overall clinician experience. While vendors are committed to be able to deliver the system using the common language in Norway according to the policy "Felles språk", there has been challenges in Norway with poorly translated systems from one of the global megasuites. This may risk inefficiency, reduced patient security and clinician burnout (Direktoratet for e-helse, October 2019). Using demos and quality checking translations should be one of a healthcare organization's priorities when acquiring new EHR products. This area also presents an opportunity for the EHR vendors to improve the translations from their systems native language.

The responses also indicate *a* high number of on-premises solutions still in use in Norwegian health delivery organizations. Gartner has observed this to be the case in other Nordic countries, where health delivery organizations face barriers when migrating to newer solutions offered by the vendors and having a wider support for particular use cases. Despite the push from the vendors for their users to migrate to these new solutions and possible interest from the end-users to adopt these solutions, the most widely used EHRs are still hosted on-premises. Interestingly, both the data provided by vendors in this survey and other reports show a trend of two or more EHR solutions being used in parallel in specific use cases (Felles kommunal journal interim AS, 2022). This may present vendors with areas for further innovation. It also presents user organizations an opportunity to consider consolidation/rationalization to more modern EHRs or to merging existing solutions.

The Norwegian market currently provides a vibrant environment of multiple EHR solutions targeted at a variety of use cases. The vendors' responses to the report show commitment towards further adoption of standards increasing interoperability between systems and enhancing the ability to connect their EHR solutions into analytics and business intelligence applications. With the availability of increasing amounts of data from sources such as

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wearables, self-triage solutions and testing offered by consumer health actors, both clinicians and patients will need increasingly strong capabilities to leverage data for treatment and preventive care.

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4. Conclusion

The Norwegian market currently provides a vibrant environment of multiple EHR solutions targeted at a variety of use cases. Going forward this sustainable, rich ecosystem can support innovation within the digital health space. Many of the same EHR (and/or patient registry solution) vendors that were present in the Norwegian market in 2014 are still active. In addition, the market has seen a number of new emerging players and increasing interest from international vendors to either enter the market or increase their market share.

The development focus areas among the vendors currently present in Norway are similar to those Gartner sees globally. Vendors (including those with legacy solutions still in use) are aiming to transition their customers to newer solutions, including solutions that are cloud-hosted, and solutions with increased architectural flexibility via, for example, support for APIs.

The emergence of openEHR and wider digital health platforms is reflected in the majority of vendor development activities. Many of the vendors seek to further develop their products according to commonly used standards to enhance intra- and interoperability. Based on the responses received, most solutions currently in the market follow the mandatory and recommended standards in the Norwegian market and there are ongoing development efforts to further enhance the support for recommended standards.

The EHR market in Norway has adopted and will continue to adopt advancements in technology that improve clinical practices and patient care. One of these advancements is prescriptive and insightful intelligence (AL/ML/BI), which utilizes advanced CDS to streamline care services, predict demand for care, and assign appropriate care pathways. Clinical communication and collaboration tools simplify and secure care team collaboration, reducing EHR-associated physician burnout and improving EHR user experience. These tools support mobile GPs and enable EHR access from any workstation or mobile device, increasing convenience for the care team. Other important developments are the adoption of virtual visits, remote patient engagement, and continuous monitoring, all of which aim to reduce unnecessary care and ensure that patients receive prompt care from the right experts at the right time and place.

Overall, the Norwegian market has a wide range of solutions that target different user segments with a varying level of functional capabilities offered. Although most of capabilities considered as fundamental are supported by most solutions, there are capability areas that are only supported by some of the current solutions - especially in the areas of clinical operations' efficiency, population level reporting, advanced analytics and clinician and patient experience. These areas may provide useful development opportunities for vendors present or interested in the market, provided that solutions meet requirements in terms of functionality, user friendliness, flexibility, and right price point for a set of varying use cases. Other publications indicate user dissatisfaction and perceived lack of capability support for certain user groups or use cases, especially in the primary care sector.

In Europe, countries have traditionally selected best of breed EHR solutions to serve the needs of individual health delivery organizations. The emergence of digital health platforms that will support interconnection of EHR products with multiple other solutions, require increasingly strong integration capabilities to allow intra- and interoperability within and outside these platforms. Many of the vendors responding to this survey have sought to respond to these challenges by designing their solutions with the wider ecosystem of data exchange in mind. However, there are vendors that provide a wide set of functional capabilities within their platform and therefore offer an alternative approach without the need for implementing extensive integration to a multitude of third-party solutions. As EHR solutions serve a wide range of organizations with different needs and use cases, it is beneficial to have options present in the market for decision makers and health delivery organizations to find a solution that best meets their needs.

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5.   Limitations and areas for further analysis

This report focuses solely on the responses received from EHR vendors and does not include the perspective of users/user groups. Therefore, to form a complete view of how well EHRs meet user needs, it is essential to consider user requirements to ensure that the solutions offered meet the needs of all stakeholders involved in the delivery of care.

Areas that this report has not considered:

- User perspective: This report does not assess whether the capabilities and functionalities provided by EHR vendors are aligned with the actual requirements of healthcare providers. Consequently, it is possible that some user groups may not be fully served by the available capabilities of EHRs. A study that only considers the vendor perspective cannot fully capture the impact of EHR solutions on patient care and outcomes (e.g., may not properly capture important factors such as usability, workflow integration, and patient safety).

- Limitations in current deployments: Several municipalities have EHRs with limited functionality and difficulties with information exchange. This creates challenges for healthcare personnel who need information from other healthcare providers to make decisions about which treatment should be provided. Additionally, some EHRs in the municipalities are based on outdated technology and architecture, resulting in inefficient development and long release cycles. Low adoption rate of EHRs or their modules catering to specific user segments can lead to low user satisfaction. Many municipalities experience delays in upgrading to the latest version, which is indicated by slow connection to national cooperation solutions. (Direktoratet for e-helse, 2022)

- Approaches to overcoming barriers to migration: To ensure the development and adoption of effective and beneficial EHR solutions, it is crucial to consider potential barriers that hinder the specific needs of healthcare providers in different regions and settings. These barriers may include high migration costs, specific technical requirements, data lock-in, lack of user support, and local adaptation of each product.

To conclude, there are certain limitations that arise from not gathering data from the users or the organizations using the EHR solutions. These limitations are with the investigation and this report, rather than the EHR systems themselves. The report has not evaluated possible mismatches between the capabilities offered by EHR solutions and the needs of healthcare providers. Neither has the report considered how EHR products impact efficiency, productivity, patient care, and outcomes or gone into detail on challenges with information exchange and outdated technology that may be concerns in certain municipalities To obtain a holistic view of the current state of the EHR market, it would be valuable to conduct thorough evaluations from the user perspective, taking into account the unique needs of different regions.

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Appendices

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6. List of figures

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7. List of tables

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8.   List of abbreviations

Abbreviation	Explanation
ADT	Admission, Discharge and Transfer
AI	Artificial Intelligence
BI	Business Intelligence
CPOE	Computer-Based Physician Order Entry
DHP	Digital Health Platforms
EHDS	European Health Data Space
EHR	Electronic Health Record
FHIR	Fast Healthcare Interoperability Resources
GP	General Practitioner
ICT	Information and Communications Technology
ML	Machine Learning
NLP	Natural-Language Processing
PASs	Patient Administration Systems
RPM	Remote Patient Monitoring
RWE	Real World Evidence
TCO	Total Cost of Ownership
UI	User Interface
XDS	Cross Enterprise Document Sharing

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9.   List of definitions

9.1.   Definitions of key terms used in this report

Term	Definition
Ambient digital scribes	Ambient digital scribes are intelligent documentation support systems that leverage speech recognition, NLP, AI and ML to automate documentation of the spoken aspects of a clinical encounter. These solutions use ambient listening and speech recognition technology to convert captured audio to text. Relevant information from the clinical encounter is extracted and summarized before being uploaded to the EHR. Currently available solutions rely on a quality check process that is performed remotely by a human before the note is presented to the clinician for review and signoff (see Figure 3). Ambient digital scribes are activated through a mobile app or specific hardware. Some hardware solutions also include a camera to capture nonverbal information, such as location of symptoms, physical examination findings and mobility aids.
Computer-Based Provider Order Entry (CPOE)	Computer-based provider order entry (CPOE) refers to a physician's direct input of orders (medication and nonmedication) into an acute care (inpatient) automation system. We use physician order entry to emphasize that the ordering clinician — not someone operating on his/her behalf — needs to interact with the system.
Digital scribes	Digital scribes use AI and a conversational interface to structure and complete the clinician spoken note within the correct fields of the EHR. They use machine learning (ML) to increase accuracy over time; through individual clinician profiles, the solutions are able to learn attributes such as preferences, preferred terminology, accents and speaking styles. The note structure can be customized to the unique needs of different clinical areas and roles. These solutions have the ability to identify when users are speaking in syntactic mode (dictation), in semantic mode (commands), and often incorporate virtual assistant capabilities, enabling navigation through the EHR using a conversational user interface.
Digital transcription	Digital transcription solutions create verbatim transcripts of dictated speech in real time, and when compared to typed notes are more complete and of a higher quality. Clinicians dictate directly into the text field where the software transcribes in real time. Digital transcription solutions require the clinician to speak in a structured manner. They must dictate exactly as they want to see it in the note, using commands for punctuation, to identify the correct fields in the EHR to document, and to invoke documentation templates and standard text.
Electronic Health Record (EHR)	An electronic health record (EHR) refers to an electronic documentation system that provides the most "clear and comprehensive presentation of the patient's health condition", cf. Section 4 of the Patient Records Regulations. An EHR system contains patient-centric, electronically maintained information about an individual's health status and care, focuses on tasks and events directly related to patient care, and is optimized for use by clinicians. The EHR provides support for all activities and processes involved in the delivery of clinical care. An overview of what information this may be follows from Section 5-8 of the Patient Records Regulations, including e.g.: • Patient's and next of kin's personal data, • Formal information about the healthcare,

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Term	Definition
	• Patient's health contacts, and
	• Information about medical history, findings, assessments, treatments and health documentation/certificates/sick leave, etc.
	Systems that only take care of parts of such documentation systems are not considered EHR in this report, examples of such are professional systems for image processing, response center services, digital home follow-up, or administrative systems for attendance registration, patient logistics, etc.
FHIR	FHIR stands for Fast Healthcare Interoperability Resources and it is a set of standards for healthcare data exchange; it is a substantial advance in how healthcare provider organization access and process important care delivery data. HL7 created the FHIR specification to provide a modern API solution for HL7 that takes advantage of current web standards such as JSON, XML and URI to make interfaces easier to understand, develop and use.
HL-7	HL-7 stands for Health Level 7 and it is a set of clinical standards and messaging formats that provide a framework for the management, integration, exchange and retrieval of electronic information across different healthcare systems.
OpenEHR	OpenEHR is a technology for e-health, consisting of open specifications, clinical models and software that can be used to create standards, and build information and interoperability solutions for healthcare.
Smart EHR UI	Smart electronic health record (EHR) user interface (UI) solutions use AI and ML to synthesize, summarize and elevate relevant clinical data from the EHR and other clinical data sources, creating a contextualized view of the patient record. These solutions are integrated within the primary EHR UI, providing a seamless experience to the clinicians and end -users.
SNOMED CT	Systematized Nomenclature of Medicine, Clinical Terms. A nomenclature created by the College of American Pathologists (CAP) for use in pathology. SNOMED has gradually been extended to cover other domains of medicine. It contains over 150,000 items and includes coverage for numerous medical specialties.

9.2. Definitions of EHR system capabilities

Term	Definition
Advanced clinical decision support (CDS) capabilities, based on AI and ML	Ability of the EHR systems to provide advanced clinical decision support tools utilizing for example: • AI (artificial intelligence) • ML (machine learning) • NLP (natural language processing).
Care coordination capabilities	Ability of the EHR to securely share patient information between multiple parties giving care, including deliver this information across organizational boundaries and between disparate, nonintegrated systems. For example: • Support the orchestration and tracking of care pathways over time

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Term	Definition
	across the care venues included in the integrated implementation • Alerting clinicians proactively to ensure that the patient is being treated and managed appropriately.
Clinical decision support (CDS) capabilities, rule based CDS	Ability of the EHR systems to provide clinical decision support tools to help healthcare providers make informed treatment decisions and the capability to incorporate rules and decisions to more-sophisticated support the clinical care processes. For example: • Rule capability for a limited set of data items (e.g., alerts for drug-drug interactions and drug allergies), CDS rules based on normalized concepts, CDS toolset supports both vendor and client creation and maintenance of rules • Operation in both a real-time and a near-real-time manner and provides feedback to users at the earliest possible time • Reminders for preventive care services, "Proactive" alerts (for example, "Your patient on gentamicin now has worsening renal function. Do you want to lower dose?") are supported • Guidelines for managing chronic conditions • Notifications (for example, paging, e-mail, and creating an item to be viewed by any person who reviews that patient's clinical results display) • Supports interactions with the other EHR core capabilities, especially DM workflow, order entry and clinical documentation • Logging and auditing tracks the execution of rules and the resulting decision results.
Clinical display/dashboard capabilities	Ability of the EHR to present the captured data in a meaningful manner that contributes to the clinician's ability to use the data effectively. Configurability is essential. For example: • Physician and nurse clinical dashboards and clinical and performance for specific uses (e.g., ambulatory, ED, ICU, and medical/surgical floors) • Data can be presented in different manner depending on clinician role (e.g. nurses, cardiologists and internists) • End-users can create configurable representations of clinical data, including the ability to create custom graphs from data in the CDR • Patient summary views can be configured to meet the needs of clinicians (for example what data fields are included as part of the summary) • Appropriate display on multiple form factors available (such as fixed-desktop, wireless tablet or personal digital assistant) • User can indicate that a specific result or alert has been seen and what action was taken so that another user can easily determine what was done and when.

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Term	Definition
Clinical documentation and data capture capabilities	Ability of the EHR systems to capture a wide range of patient data, including medical history, medication lists, allergies, lab results, and vital signs. This data should be easily accessible to authorized users and should be kept up-to-date and accurate. Be capable of capturing all clinically relevant information at the point of care. It could enable the creation of various types of clinician notes, enable the acquisition of information from devices, be a way to import data from clinical systems within the organization and will ultimately need to input and integrate clinical information from outside the organization. For example: • Consists of scanned documents, transcribed texts, uploading or scanning results from systems in the EHR environment • Documentation tools, direct entry of nursing assessments and forms for acquisition of clinical information • Previously documented items or sections can be brought forward and added to a current documentation episode (for example, a paragraph on past medical history could be moved from a previous encounter and added to the current history) • Physician documentation (for example, problem lists, diagnoses, allergies and current medications, but perhaps not progress notes) as discrete data items for ambulatory, ED, ICU, and medical/surgical care venues • Support for ancillary (for example, respiratory therapists, physical therapists and social workers) clinician documentation • Ability to capture data as discrete items • Clinical documentation episode can be triggered by execution of a workflow step or entry of an order • Forms created by clinicians for data collection can be linked to decision support to ensure logical consistency, and to generate appropriate alerts and reminders during the documentation process.
Clinician experience capabilities	Ability of the EHR to support clinical experience, for example: • Mobility • Personalization • User Analytics • System Education • Speech Recognition / Digital Transcription • Clinical Communication and Collaboration.
Clinical research and RWE capabilities	The ability of the EHR to support research, for example: • Real-world evidence (RWE) that derives insights from real-world data (RWD). • Clinical trials • Clinical registries.
Clinical specialty capabilities	The ability of the EHR systems to support clinical specialty areas, such as Anesthetics, Allied Health, Ambulatory Care, Behavioral Health, Cardiology, Cardiothoracic, Community Care, Endoscopy, Dental and Oral Health, Dermatology, Ear, Nose and Throat, Emergency, Endocrinology, Gastroenterology, General Medicine, Genomics, Geriatric Medicine, Gynecology, Hematology, Home Care, Immunology, Intensive Care (ICU and NICU), Infection Control, Maternity, Neurology, Oncology, Operating Theatre, Ophthalmology, Orthopedics, Palliative Care, Pediatrics, Radiation Oncology, Rehabilitation Medicine, Renal, Respiratory Medicine, Rheumatology, Sleep Medicine, Sexual Health, Trauma, Urology.

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Term	Definition
Clinical workflow advanced capabilities	Ability of the EHR to support additional workflows involved in clinical care and manage the information needed. These EHR workflow capabilities enable the organization to define key processes so that the EHR can assist humans and automated systems in reliably carrying out these processes. For example: • Central process management capability for clinical process support • Health delivery organization IT staff can create and maintain workflows with minimal or no support from the EHR vendor • Permits the creation and use of a large array of defined processes — at least hundreds • Supports the definition and use of roles to enable both humans and automated systems to participate in a process • Work queue capability to queue steps for processing by humans and by automated systems • Supports the inclusion of branching logic, serial and parallel processes, and logging capabilities.
Clinical workflow basic capabilities	Ability of the EHR to support the basic processes involved in clinical care and manage the information needed for those. Basic capabilities include e.g: • Document signing, transcription • Support for diagnostic processes, such as order, receiving and signing for laboratory tests / imaging • Central basic process management capability.
Data model capabilities	Ability of the EHR system the access to a flexible permanent data store. For example: • Database design with structured data • A uniform file system with a flexible underlying data structure • Data can be amended or annotated but not deleted or changed • An audit trail exists to track who entered, amended or annotated the record • A formal database management system that includes independent metadata • Medical data represented in a variety of forms (for example, textual reports stored as document images, textual reports stored as text — or XML — and finely structured, explicitly coded data amenable to computer processing). • Ability to extend the data model if necessary.
EHR system management, privacy and access management	A rich set of functionality and services that are focused on making the overall system easier to understand, configure, provision, maintain, and monitor. For example: • Ability to customize EHR system to meet with healthcare delivery organization's particular needs. • Ability to utilize third party add-ons or custom-developed modules on the EHR system. • Ability to manage the system upgrades • Offline access • User access management: authentication to system resourced, strong passwords, role based access control, access logs / audit logs, session timeout, two-factor authentication (hardware tokens, biometric device), dynamic role-based access to system resources based upon the organization's structure, business rules and/or security policies, and ability to override authorization restrictions (break the glass) including creating an audit trail for why the restriction was "ignored") • Disaster recovery, backup and restore of important components,

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Term	Definition
	and ability to participate in "storage-facilitated disaster recovery" (database snapshots, replication) • Statistics from infrastructural components.
Integration and Interoperability capabilities	Ability of the EHR system to communicate and interact with other systems in the EHR environment (share data with other healthcare systems, such as lab systems, imaging systems, and prescribing systems), and eventually with systems outside of the organization. This allows healthcare providers to access a complete picture of a patient's health and facilitates coordination of care across multiple providers. For example: • Accept computer-processable data from admitting and registration systems • Accept data from lab, pharmacy, radiology and other clinical or transcription systems • Send computer-processable billing data to patient accounting systems • Send text reports of visits and procedures documented in the EHR system • Accept computer-processable lab results, medication order/prescription history and medicine-administration data • Send computer-processable orders • Accept computer-processable order status information for progress tracking • Send computer-processable medication administration.
Order management (both medication and nonmedication orders) capabilities	Ability of the EHR to include direct entry of both medication and nonmedication orders (for example, consult requests, lab tests or imaging studies). The EHR can support a variety of mechanisms for order entry, including traditional approaches in which physician orders are written and then transcribed by the medical staff, as well as direct entry of orders by physicians into the EHR. For example: • Ability to transcribe physician written or verbal orders and then send them to the pharmacy • Integrated (not interfaced) clinical pharmacy functionality • Nursing orders • Physicians can enter all types of orders (for example, medication and nonmedication) • CDS integration in order to provide real-time alerts during order creation • Health delivery organization can create institution approved order sets with some ability to create and limit the creation of custom end-user-defined order sets • Ability to handle verbal orders (including automatically populating physicians' "in box" to alert them of orders needing signatures) • Ability to create "order report" (such as all orders needing to be "refilled" or co-signed) • Permits the appropriate suspension and resumption of ambulatory orders at the time of admission or discharge.
Patient administration capabilities	The ability of the EHR to support patient administration (PAS) For example: • Scheduling, registration, administration, discharge, transfer and bed management • Master patient index, patient identification, patient demographics and activity • Patient registration, clinical scheduling, bed management, referral management, waiting list management • Document scanning, medical record tracking,

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Term	Definition
	• Reimbursement / Billing • Clinical coding.
Patient engagement capabilities	The ability of the EHR systems to engage and directly interact with a patient. This can improve patient involvement in their own care and can help patients better understand and manage their health and can reach far beyond a static patient portal. For example: • Patient portals that allow patients to access their own health information, communicate with their healthcare providers, and manage their own care • Patient reported experience (PREMS) • Patient reported outcome (PROMS) • Patient Self-scheduling, registration and intake • Patient Secure Messaging • Patient Education • Prescription refills.
Reporting and analytics advanced capabilities	The ability of the EHR systems to support advanced reporting and analytics needs. For example: • Population health management (e.g., trend monitoring and analysis) • Public health reporting support (e.g., reporting of infectious disease) • Advanced analytics capabilities with the ability to combine data from external data sources.
Reporting and analytics basic capabilities	The ability of the EHR systems to support operational and clinical reporting such as simple standard reports and the ability to export data from any module into a centralized data repository for reuse.
Security capabilities	EHR systems should have robust security and privacy protections to safeguard patient data. For example: • Measures to prevent unauthorized access to patient data. • Ensure that data is only shared with authorized users. • Cybersecurity capabilities.
Telemedicine / Virtual care capabilities	The ability of the EHR systems to support the planning of phone or video appointments between a patient and their healthcare practitioner. This will be either by providing telemedicine tools, provisioning telemedicine tools via ancillary solutions; integration with telemedicine solutions or other suitable solutions (such as MS Teams).

9.3. Definitions of system architecture

Term	Definition
Modular architecture (Modular suite)	This is a collection of software products that are designed to work together as a system, but can also be independently developed, deployed and managed.
Monolithic architecture (One application suite)	A system where all the components and functionality are tightly integrated within a single, unified system. In an EHR system context, this means that the EHR system is built as a single and large self-contained application rather than many smaller modular components.

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Term	Definition
Platform architecture	EHR system works as a platform for other components provided by the EHR vendor or 3rd party vendors. These components can vary in nature from being fully custom developed, to configurable out of the box solutions, or be a combination of these.

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