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العنوان باللغة العربية

التحليلات التنبؤية في إدارة الموارد البشرية الإلكترونية: تحسين الاحتفاظ المواهب والتخطيط للقوى العاملة في مؤسسات الرعاية الصحية بالمملكة العربية السعودية

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حقوق الطبع والنشر

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تعود ملكية حقوق الطبع والنشر لجميع المواد والمحتويات الواردة في هذه الرسالة إلى جامعة ميدأوشن. ولا يجوز نسخ أي جزء من هذه الرسالة أو إعادة إنتاجه أو تخزينه في أي نظام لاسترجاع المعلومات أو نقله بأي وسيلة كانت، سواءً إلكترونية أو ميكانيكية أو بالتصوير أو التسجيل أو بأي وسيلة أخرى، إلا بعد الحصول على موافقة خطية مسبقة من جامعة ميدأوشن، وذلك وفقًا للأنظمة واللوائح المعمول بها

المخلص

شهدت تقنيات التحول الرقمي تطوراً متسارعاً أدى إلى إحداث تغييرات جوهرية في ممارسات إدارة الموارد البشرية داخل مؤسسات الرعاية الصحية، مما أتاح فرصاً جديدة لتحسين إدارة القوى العاملة من خلال توظيف الأساليب المعتمدة على البيانات. هدفت هذه الدراسة إلى بحث دور التحليلات التنبؤية في أنظمة إدارة الموارد البشرية الإلكترونية (E-HRM) وأثرها في تحسين الاحتفاظ بالمواهب وتخطيط القوى العاملة في مؤسسات الرعاية الصحية بالمملكة العربية السعودية. كما سعت الدراسة إلى اختبار التأثير المباشر لتبني التحليلات التنبؤية على الاحتفاظ بالمواهب وتخطيط القوى العاملة، ودراسة الدور الوسيط لاتخاذ القرارات في الموارد البشرية المبنية على البيانات، بالإضافة إلى الدور المعدل للمعوقات التنظيمية في هذه العلاقات. واعتمدت الدراسة المنهج الكمي باستخدام تصميم المسح المقطعي، حيث جمعت البيانات من العاملين في مؤسسات الرعاية الصحية التابعة لوزارة الصحة السعودية باستخدام استبانة مبنية على مقاييس علمية معتمدة. وتم تحليل البيانات باستخدام البرنامج الإحصائي للحزم الإحصائية للعلوم الاجتماعية (SPSS)، من خلال الإحصاءات الوصفية، واختبارات الثبات، ومعامل ارتباط بيرسون، وتحليل الانحدار المتعدد، وتحليل الوساطة. والتعديل باستخدام أداة Hayes Process Macro

أظهرت نتائج الدراسة أن تبني التحليلات التنبؤية كان له تأثير إيجابي ذو دلالة إحصائية على كل من الاحتفاظ بالمواهب وتخطيط القوى العاملة. كما بينت النتائج أن اتخاذ القرارات في الموارد البشرية المبنية على البيانات يؤدي دوراً وسيطاً جزئياً في العلاقة بين التحليلات التنبؤية وكل من الاحتفاظ بالمواهب وتخطيط القوى العاملة، مما يشير إلى أن المؤسسات تحقق قيمة أكبر من التحليلات التنبؤية عندما تُوظف مخرجاتها في صنع القرارات الاستراتيجية المتعلقة بالموارد البشرية. كذلك أوضحت النتائج أن المعوقات التنظيمية، والتي تشمل ضعف البنية التحتية التقنية، ومحدودية القدرات التحليلية، ومقاومة التغيير التنظيمي، تُضعف بشكل ملحوظ التأثيرات الإيجابية للتحليلات التنبؤية على الاحتفاظ بالمواهب وتخطيط القوى العاملة. وبصورة عامة، تمكن النموذج البحثي المقترح من تفسير نسبة كبيرة من التباين في مخرجات القوى العاملة، مما يؤكد الأهمية الاستراتيجية للتحليلات التنبؤية في إدارة الموارد البشرية الحديثة داخل مؤسسات الرعاية الصحية.

وخلصت الدراسة إلى أن دمج التحليلات التنبؤية في أنظمة إدارة الموارد البشرية الإلكترونية (E-HRM) يسهم بصورة فعالة في تعزيز اتخاذ القرارات المبنية على الأدلة، وتحسين الاحتفاظ بالموظفين، وتطوير تخطيط القوى العاملة، والارتقاء بالأداء المؤسسي في مؤسسات الرعاية الصحية السعودية. كما أكدت النتائج أهمية تنمية القدرات التحليلية، وتحسين جودة البيانات، وتعزيز البنية التحتية الرقمية، وترسيخ ثقافة تنظيمية قائمة على اتخاذ القرارات المبنية على البيانات؛ وذلك لتحقيق أقصى استفادة من تطبيقات التحليلات التنبؤية. وتسهم هذه الدراسة في إثراء الأدبيات العلمية من خلال تقديم إطار متكامل يربط بين التحليلات التنبؤية، واتخاذ القرارات في الموارد البشرية المبنية على البيانات، والمعوقات التنظيمية، والاحتفاظ بالمواهب، وتخطيط القوى العاملة في سياق الرعاية الصحية السعودية. كما تقدم مجموعة من التوصيات العملية التي يمكن أن يستفيد منها قادة القطاع الصحي وصانعو السياسات لدعم مستهدفات رؤية المملكة العربية السعودية 2030 في مجال التحول الرقمي والتنمية المستدامة للقوى العاملة في القطاع الصحي.

الكلمات المفتاحية : الاحتفاظ بالمواهب، التخطيط (E-HRM) التحليلات التنبؤية، إدارة الموارد البشرية الإلكترونية للقوى العاملة، اتخاذ القرارات في الموارد البشرية المعتمد على البيانات، العوائق التنظيمية، المؤسسات الصحية السعودية

Abstract

The rapid advancement of digital technologies has transformed HRM practices across healthcare organizations, creating new opportunities to improve workforce management through data-driven approaches. This study examined the role of predictive analytics in E-HRM systems and its impact on talent retention and workforce planning in Saudi healthcare organizations. Specifically, the study investigated the direct effects of predictive analytics adoption on talent retention and workforce planning, the mediating role of data-driven HR decision-making, and the moderating effect of organizational barriers on these relationships. A quantitative research approach employing a cross-sectional survey design was adopted. Data were collected from employees working in Saudi Ministry of Health (MOH) healthcare organizations using a structured questionnaire adapted from validated measurement scales. The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), including descriptive statistics, reliability analysis, Pearson correlation, multiple regression analysis, and mediation and moderation analyses using Hayes' PROCESS Macro.

The findings indicated that predictive analytics adoption had a significant positive effect on both talent retention and workforce planning. Data-driven HR decision-making was found to partially mediate the relationships between predictive analytics and the two workforce outcomes, demonstrating that organizations derived greater value from predictive analytics when analytical insights were incorporated into strategic HR decisions. Furthermore, organizational barriers, including inadequate technological infrastructure, limited analytical capabilities, and resistance to organizational change, significantly weakened the positive effects of predictive analytics on talent retention and workforce planning. Overall, the proposed research model explained a substantial proportion of the variance in workforce outcomes, highlighting the strategic importance of predictive analytics in modern healthcare Human Resource Management (HRM).

The study concluded that integrating predictive analytics into Electronic Human Resource Management (E-HRM) systems can significantly enhance evidence-based decision-making, improve employee retention, strengthen workforce planning, and support organizational performance within Saudi healthcare organizations. The findings also emphasized the importance of developing analytical competencies, improving data quality, strengthening digital infrastructure, and fostering a culture of data-driven decision-making to maximize the benefits of predictive analytics. The study contributes to the existing literature by providing an integrated framework that combines predictive analytics, data-driven HR decision-making, organizational barriers, talent retention, and workforce planning within the Saudi healthcare context. It also offers practical recommendations for healthcare administrators and policymakers seeking to support the objectives of Saudi Vision 2030 through digital transformation and sustainable healthcare workforce development.

Keywords: Predictive Analytics, (E-HRM), Talent Retention, Workforce Planning, Data-Driven HR Decision-Making, Organizational Barriers, Saudi Healthcare Organizations.

التقدير والشكر

بسم الله الرحمن الرحيم

الحمد لله رب العالمين، حمداً يليق بجلال وجهه وعظيم سلطانه، الذي بنعمته تتم الصالحات، وبتوفيقه تتحقق الغايات. أحمدته سبحانه وأشكره على ما أولاني من فضله، وما منحني من القوة والعزيمة والصبر لإتمام هذا البحث، وأسأله أن يجعله عملاً خالصاً لوجهه الكريم، نافعاً للعلم وأهله.

وانطلاقاً من قوله صلى الله عليه وسلم **من لا يشكر الناس لا يشكر الله**، يسعدني أن أتقدم بخالص الشكر وعظيم الامتنان لكل من كان له فضل في إنجاز هذه الدراسة، وأسهم بعلمه أو دعمه أو تشجيعه في مختلف مراحلها.

أتقدم بجزيل الشكر والتقدير إلى **جامعة ميدأوشن**، لما وفرت من بيئة أكاديمية متميزة، وبرامج تعليمية وبحثية رفيعة المستوى، وما قدمته من إمكانيات وتسهيلات أسهمت في إتمام هذه الدراسة وتحقيق أهدافه.

كما أتقدم بخالص الامتنان والتقدير إلى مشرفي الكريمين **الدكتور محمد عبد الحميد الفيصل والدكتور فايز علي جراد**، على ما أولاني من اهتمام ورعاية علمية، وما قدماه من توجيه سديد، ونصح مخلص، وملاحظات علمية دقيقة، ومتابعة مستمرة طوال مراحل إعداد هذه الرسالة. لقد كان لخبرتهما الأكاديمية الواسعة، وحرصهما على جودة العمل العلمي، أثر بالغ في تطوير هذه الدراسة وإخراجها بالصورة التي أرجو أن تكون عليها، فلهما مني أصدق مشاعر الشكر والتقدير.

كما أتوجه بالشكر الجزيل إلى السادة المحكمين على تفصلهم بتحكيم أداة الدراسة، وإثرائها بملاحظاتهم العلمية القيمة، والتي أسهمت في تحسينها وتعزيز جودتها. وأعرب كذلك عن خالص امتناني لجميع المشاركين في الدراسة، الذين أبدوا تعاوناً كريماً وقدموا وقتهم وجهدهم للإجابة عن الاستبانة، مما كان له بالغ الأثر في إنجاز الجانب الميداني من هذا البحث.

وأتقدم بالشكر والتقدير إلى جميع أعضاء الهيئة الأكاديمية والباحثين والمؤلفين الذين أفدت من نتائجهم العلمي، وكان لأعمالهم وإسهاماتهم الفكرية دورٌ أساسي في بناء الإطارين النظري والمنهجي لهذه الدراسة، وإثراء محتواها العلمي.

أما أسرتي العزيزة، فهي صاحبة الفضل بعد الله في كل ما وصلت إليه. أتوجه إليها بخالص المحبة والعرفان، فقد كانت سندي الحقيقي طوال هذه المسيرة، وغمرتني بدعائها، وصبرها، وتشجيعها، وثقتها الدائمة بقدرتي على تجاوز التحديات وتحقيق هذا الإنجاز. كما أتقدم بالشكر إلى أصدقائي وزملائي الذين لم يخلوا عليّ بالدعم والمساندة والكلمة الطيبة، وكان لتشجيعهم أثر كبير في مواصلة الطريق.

وفي الختام، أتقدم بالشكر والعرفان لكل من أسهم، بقليل أو كثير، بصورة مباشرة أو غير مباشرة، في إنجاز هذه الرسالة. وأسأل الله تعالى أن يجزي الجميع خير الجزاء، وأن يجعل هذا العمل نافعاً، وأن يكتب له القبول، ويوفقنا جميعاً إلى خدمة العلم والمعرفة، إنه ولي ذلك والقادر عليه.

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LIST OF TERMINOLOGY

Term	Definition
Predictive Analytics	The application of statistical techniques, machine learning, and historical data to predict future events and support proactive organizational decision-making.
Electronic Human Resource Management (E-HRM)	The use of digital technologies and information systems to automate and enhance strategic human resource management functions.
Human Resource Management (HRM)	The strategic management of an organization's workforce through recruitment, development, performance management, and employee retention.
Talent Retention	An organization's ability to attract, develop, and retain skilled employees while minimizing voluntary turnover.
Workforce Planning	The systematic process of forecasting workforce requirements and ensuring that the organization has the appropriate number of employees with the required skills at the right time.
Data-Driven HR Decision-Making	The process of making human resource decisions based on data analysis, empirical evidence, and analytical insights rather than intuition.
Organizational Barriers	Internal organizational factors that hinder the successful implementation of predictive analytics, including inadequate infrastructure, poor data quality, limited analytical capabilities, and resistance to change.
Digital Transformation	The integration of digital technologies into organizational processes to improve efficiency, innovation, and overall organizational performance.
Human Resource Information System (HRIS)	A computerized system designed to collect, store, manage, and analyze employee and human resource information.
Human Resource Analytics	The systematic analysis of workforce data to improve human resource policies, practices, and strategic decision-making.
Evidence-Based Human Resource Management	An HR management approach that relies on research findings, organizational data, and analytical evidence to support decision-making.
Workforce Analytics	The application of analytical methods to workforce data to generate insights that improve organizational and HR performance.
Workforce Forecasting	The process of estimating future workforce supply and demand to support staffing and resource allocation decisions.
Strategic Human Resource Management (SHRM)	A strategic approach that aligns human resource practices with the long-term objectives and competitive strategy of the organization.

Term	Definition
Succession Planning	The systematic identification and development of employees to fill key leadership and critical organizational positions in the future.
Organizational Performance	The extent to which an organization effectively and efficiently achieves its strategic objectives.
Employee Turnover	The rate at which employees leave an organization and are replaced over a specified period.
Healthcare Workforce	The collective group of healthcare professionals and support personnel responsible for delivering healthcare services.
Machine Learning	A branch of artificial intelligence that enables computer systems to learn from data and improve predictions without explicit programming.
Artificial Intelligence (AI)	Computer systems capable of performing tasks that normally require human intelligence, including learning, reasoning, and decision-making.

List of Abbreviations

Full Meaning	Abbreviation
Artificial Intelligence	AI
Electronic Human Resource Management	E-HRM
Human Resources	HR
Human Resource Information System	HRIS
Human Resource Management	HRM
Institutional Review Board	IRB
Information Technology	IT
Job Demands–Resources	JD-R
Management Information System	MIS
Ministry of Health	MOH
Strategic Human Resource Management	SHRM
Statistical Package for the Social Sciences	SPSS
World Health Organization	WHO

Chapter One

Introduction

1.1 Introduction

The rapid advancement of digital technologies has fundamentally transformed the management of healthcare organizations worldwide. Healthcare systems are increasingly adopting digital solutions to improve operational efficiency, optimize resource utilization, and enhance the quality of healthcare services. Among these technological developments, E-HRM has emerged as a strategic innovation that enables healthcare organizations to automate human resource functions, improve workforce management, and support evidence-based decision-making (Bondarouk & Ruël, 2009; Strohmeier, 2007).

In recent years, HRM has evolved from a primarily administrative function to a strategic organizational partner responsible for attracting, developing, and retaining talented employees. This transformation has been accelerated by digital technologies that enable healthcare organizations to collect, store, analyze, and utilize workforce data more effectively than ever before (Marler & Boudreau, 2017). Rather than relying solely on traditional human resource practices, modern organizations increasingly employ advanced analytical techniques to guide recruitment, workforce planning, employee development, succession planning, and retention strategies.

Healthcare organizations represent one of the most knowledge-intensive sectors, where the availability of qualified healthcare professionals directly influences patient safety, service quality, and organizational performance. Consequently, effective workforce management has become a strategic priority for healthcare administrators worldwide. Human resources (HR) account for the largest proportion of healthcare expenditure, making efficient workforce planning and employee retention essential components of sustainable healthcare delivery (World Health Organization [WHO], 2023).

The Kingdom of Saudi Arabia has undergone substantial healthcare transformation under the framework of **Saudi Vision 2030**, which seeks to improve healthcare accessibility, efficiency, quality, and sustainability through extensive digital transformation initiatives (Kingdom of Saudi Arabia, 2016). Digital health programs introduced by the MOH have included electronic medical records, telemedicine, artificial intelligence (AI) applications, electronic health services, and integrated digital management systems. Parallel to these developments, E-HRM systems have been increasingly implemented to modernize workforce administration and facilitate data-driven management of healthcare personnel (Al-Hanawi et al., 2019).

E-HRM to the integration of information and communication technologies into human resource processes to automate administrative activities while simultaneously supporting strategic HR decision-making. Modern E-HRM systems extend beyond payroll processing and employee records by incorporating recruitment management, performance appraisal, competency assessment, workforce scheduling, learning management, succession planning, and employee engagement platforms (Bondarouk & Brewster, 2016). These integrated systems generate large volumes of workforce data that can serve as valuable organizational assets when appropriately analyzed.

The increasing availability of workforce data has created opportunities for organizations to move beyond descriptive reporting toward predictive and prescriptive analytics. Predictive analytics utilizes statistical techniques, machine learning algorithms, AI, and historical organizational data to forecast future events and support proactive decision-making (Shmueli & Koppius, 2011). Within HRM, predictive analytics enables organizations to estimate employee turnover risk, forecast staffing requirements, identify high-performing employees, anticipate future skill shortages, and optimize workforce allocation (Levenson, 2018).

Unlike traditional HR reporting, which focuses primarily on describing historical workforce patterns, predictive analytics identifies relationships among multiple organizational variables to estimate future workforce outcomes. These analytical capabilities allow HR managers to intervene proactively before organizational problems emerge. For example, predictive models can identify employees at high risk of resignation based on demographic characteristics, performance indicators, absenteeism patterns, engagement scores, workload measures, and career progression histories (Marler & Boudreau, 2017).

Talent retention has become one of the most pressing challenges facing healthcare organizations globally. The shortage of healthcare professionals, combined with increasing patient demand, workforce aging, occupational stress, and global competition for skilled employees, has intensified concerns regarding employee turnover. High turnover among physicians, nurses, and allied health professionals disrupts healthcare delivery, increases recruitment and training costs, reduces organizational knowledge, and negatively affects patient outcomes (Hayes et al., 2012).

Healthcare organizations increasingly recognize that employee turnover rarely occurs randomly. Rather, turnover is often preceded by measurable behavioral and organizational indicators such as declining engagement, reduced performance, increased absenteeism, limited career development opportunities, workload imbalance, or decreased organizational commitment. Predictive HR analytics enables organizations to detect these warning signs early and implement targeted interventions before valuable employees decide to leave (Hausknecht & Trevor, 2011).

Workforce planning represents another critical strategic function that can benefit substantially from predictive analytics. Effective workforce planning ensures that healthcare organizations maintain appropriate staffing levels with the necessary competencies to meet current and future healthcare demands. Traditional workforce planning approaches often rely on historical staffing ratios and managerial judgment. In contrast, predictive workforce planning incorporates dynamic organizational data, demographic trends, healthcare utilization patterns, retirement projections, and workforce mobility to forecast future staffing requirements more accurately (Becker & Huselid, 2006; Minbaeva, 2018).

The integration of predictive analytics into E-HRM Management has therefore created significant opportunities for healthcare organizations to improve strategic workforce management. By combining digital HR infrastructure with advanced analytical capabilities, organizations can transform large datasets into actionable knowledge that supports evidence-based HR decision-making. This transition aligns with the broader movement toward evidence-based management, where organizational decisions are informed by empirical data rather than intuition or experience alone (Rousseau, 2006).

Despite these potential advantages, the implementation of predictive HR analytics remains relatively limited in many healthcare organizations. Existing E-HRM systems are frequently utilized primarily for administrative purposes, including attendance monitoring, payroll processing, employee records, and performance documentation. Advanced analytical functions capable of predicting workforce outcomes remain underutilized, particularly within public healthcare institutions (Angrave et al., 2016). Several barriers contribute to this limitation, including insufficient analytical expertise, fragmented HR databases, concerns regarding employee privacy, organizational resistance to technological change, limited leadership support, and inadequate integration between HR information systems and organizational decision-making processes (Minbaeva, 2018).

Within Saudi Arabia, substantial investments have been made in healthcare digitalization; however, empirical research examining predictive analytics within E-HRM remains scarce. Most previous studies have focused on digital transformation, health information systems, or E-HRM implementation rather than investigating how predictive analytics contributes to talent retention and workforce planning in healthcare organizations (Al-Hanawi et al., 2019). Consequently, healthcare

leaders have limited evidence regarding the effectiveness of predictive HR analytics in improving workforce outcomes within the Saudi healthcare context.

Furthermore, Saudi Arabia's healthcare sector is experiencing considerable workforce challenges associated with healthcare expansion, localization initiatives, changing demographic patterns, and increasing demand for highly specialized healthcare professionals. These developments necessitate more sophisticated workforce management approaches capable of anticipating staffing needs and supporting long-term organizational sustainability. Predictive analytics has the potential to address these challenges by enabling healthcare organizations to anticipate workforce trends rather than merely responding to them after they occur.

This study therefore seeks to examine the role of predictive analytics within E-HRM and its influence on talent retention and workforce planning among Saudi healthcare organizations. Specifically, the study investigates how predictive analytics adoption contributes to improved employee retention, enhances workforce planning effectiveness, and supports data-driven HR decision-making while considering the organizational barriers that may influence analytics implementation. By addressing these relationships, the study contributes to the growing literature on HR analytics and provides practical guidance for healthcare administrators seeking to leverage predictive technologies to strengthen workforce management.

Ultimately, the findings are expected to contribute to both theory and practice by expanding current knowledge regarding predictive HR analytics in healthcare while supporting Saudi Arabia's national vision for digital transformation and sustainable healthcare workforce development. As healthcare organizations increasingly rely on data-driven management, understanding the strategic value of predictive analytics within E-HRM systems becomes essential for achieving organizational excellence, workforce stability, and high-quality patient care.

2.1 Problem Statement

Healthcare is experiencing a digital transformation that has completely changed the way organizations deal with their HR. E-HRM systems have become more and more prevalent in healthcare organizations, enabling them to automate administrative processes, manage workforce data, and work more efficiently (Bondarouk & Brewster, 2016). This digital transformation has been intensified by Saudi Vision 2030 according to the country's perspective on healthcare modernization, digital innovation, and the recruitment of a sustainable and highly skilled healthcare workforce (Kingdom of Saudi Arabia, 2016). Healthcare organizations have thus made significant investments in digital HR systems to enhance workforce management and organizational performance.

Despite this progress, E-HRM systems are still in the works in many healthcare organizations. Most organizations still rely on them for administrative purposes (payrolling, attendance monitoring, employee records management, performance management), and the vast amount of data generated by these systems is not used for strategic decision-making (Marler & Boudreau, 2017). As a result, healthcare organizations will continue to rely on managerial experience and reactive decision-making instead of predictive analytics to anticipate workforce problems in order to adapt and manage human resources in the future.

Healthcare organizations face one of the most pressing workforce challenges: to retain skilled healthcare personnel. Increasing employee turnover among physicians, nurses, allied health professionals, and administrative staff is a major issue in the world and has a negative effect on organizational performance, patient care, healthcare quality, and operational costs (Hayes et al., 2012). Healthcare professionals are turnover-related as well as high employee training expenses, lost institutional knowledge, low employee morale, and disruption of healthcare service delivery. Such challenges are further aggravated in Saudi Arabia because of the increasing healthcare sector and the need for specialized healthcare professionals, the localization of healthcare staff, and ongoing reform of the healthcare system in Saudi Arabia (Al-Hanawi et al., 2019).

At the same time, healthcare organizations are facing increasing pressure to improve workforce planning in order to ensure that they can easily recruit and train qualified staff to meet current and future healthcare requirements. So workforce planning is based on accurate staffing needs forecasts, future competency gaps identified, workforce allocation optimization, and succession planning. But traditional workforce planning approaches are based on historical staffing trends and managerial judgment and are not based on more sophisticated methods to predict future workforce needs (Levenson, 2018). Therefore, healthcare organizations may face staffing shortages and resource allocation problems, increased workload, and decreased organizational effectiveness.

Predictive analytics is one of the most promising technologies for solving these workforce challenges. Data analytics using statistical models, artificial intelligence, and machine learning algorithms that are applied to historical and real-time workforce data allows organizations to forecast employee turnover, identify employees at risk of leaving, predict future staffing requirements, and support evidence-based workforce planning (Shmueli & Koppius, 2011). Organizations that successfully integrate predictive analytics into their E-HRM systems will be better able to transition from reactive HRM to proactive, strategic, and data-driven decision-making (Minbaeva, 2018).

However, there is still limited implementation of predictive analytics in healthcare HRM. Most organizations do not have the analytical capability, technological infrastructure, data quality, leadership support, and organizational readiness to implement predictive HR analytics (Angrave et al., 2016; Minbaeva, 2018) in practice and have no track records of implementation of predictive HR analytics in healthcare HRM (Angrave et al., 2016; Minbaeva, 2018). Healthcare HR departments are also hit by fragmented data systems, lack of analytical experience, privacy concerns, and resistance to change, which are barriers to the effective use of predictive analytics to improve workforce management.

For the Saudi healthcare sector, there is limited evidence of predictive analytics in E-HRM. Most previous studies have focused on digital transformation, health information

systems, and E-HRM platforms, and little attention has been given to the strategic use of predictive analytics for talent retention and staff planning (Al-Hanawi et al., 2019). Most studies on HR analytics in the world have been undertaken in private firms or businesses outside of healthcare, which makes it difficult to generalize them to Saudi public healthcare organizations.

One of the important gaps in the literature concerns the mechanisms through which predictive analytics affect workforce outcomes. While some studies have indicated that predictive analytics can improve organizational performance, very few have explored the role of data-driven HR decision-making in explaining how predictive analytics contributes to talent retention and workforce planning. Similarly, some of the organizational obstacles—in this case, technological infrastructure, lack of analytical skill, poor data quality, and organizational resistance—would hinder predictive analytics in E-HRM systems in Saudi healthcare organizations.

So, there is a major theoretical and practical gap in terms of how predictive analytics can be implemented in E-HRM in the context of workforce management in Saudi healthcare institutions. Addressing this gap is critical to support healthcare administrators, policymakers, and HR professionals in developing evidence-based workforce strategies that are in line with Saudi Vision 2030 and contribute to the sustainability of the national healthcare workforce.

Therefore, this study seeks to investigate the role of predictive analytics in E-HRM systems and its impact on talent retention and workforce planning in Saudi healthcare organizations. Additionally, this study seeks to investigate the mediating role of data-driven HR decision-making and the moderating impact of organizational barriers on these relationships. Through this study, we hope to contribute to the growing body of knowledge on HR analytics and make recommendations on workforce management through predictive analytics in the Saudi healthcare industry.

2.2 Significance of the study

This study is of importance in that it fills an important gap in the literature on predictive analytics in (E-HRM) systems and their role in talent retention and workforce planning in Saudi healthcare organizations. While healthcare organizations are increasingly adopting digital HR systems, the use of predictive analytics in the strategic context of evidence-based HRM is still being limited in the context of Saudi healthcare (Marler & Boudreau, 2017; Minbaeva, 2018). From a theoretical perspective this work contributes to the growing knowledge in HR analytics by integrating predictive analytics, E-HRM, talent retention and workforce planning and the mediating role of data-driven HR decision-making and moderating organizational barriers with the context of the HR analytics framework. Thus, it also introduces the Resource-Based View (RBV), Human Resource Analytics Framework and JD-R Model into healthcare organizations (Barney, 1991; Bakker & Demerouti, 2007). Practically, the findings will provide healthcare administrators, HR professionals and organizational leaders with evidence of how predictive analytics can be applied to identify employees at risk of turnover, improve workforce forecasting, optimize staffing decisions, and strengthen strategic workforce planning, thereby reducing recruitment costs and enhancing organizational performance (Levenson 2018; Hausknecht & Trevor, 2011). The study will also help healthcare organizations to identify the technological, organizational and human factors that are crucial to successful implementation of predictive HR analytics and to achieve better digital transformation initiatives (Angrave et al., 2016). Furthermore, the findings will have significant policy implications as they support the objectives of Saudi Vision 2030, which is based on digital transformation, human capital development and the modernization of healthcare services using the latest technologies in Saudi Arabia (Kingdom of Saudi Arabia, 2016). By providing context-specific evidence from Saudi healthcare organizations, which will guide policymakers and healthcare leaders in creating evidence-based solutions for workforce sustainability, the study will contribute to the quality of healthcare services and long-term organizational resilience (Al-Hanawi et al., 2019; World Health Organization, 2023).

2.3 Research Objective

General Objective

The primary goal of this study is to investigate the role of predictive analytics in (E-HRM) systems and its impact on talent retention and workforce planning in Saudi healthcare organizations.

Specific Objectives

1. To assess the level of predictive analytics adoption within E-HRM systems in Saudi healthcare organizations.
2. To examine the relationship between predictive analytics adoption and talent retention in Saudi healthcare organizations.
3. To evaluate the impact of predictive analytics on workforce planning effectiveness in Saudi healthcare organizations.
4. To investigate the mediating role of data-driven HR decision-making in the relationship between predictive analytics and talent retention.
5. To investigate the mediating role of data-driven HR decision-making in the relationship between predictive analytics and workforce planning.
6. To examine the moderating effect of organizational barriers on the relationship between predictive analytics adoption and talent retention.
7. To examine the moderating effect of organizational barriers on the relationship between predictive analytics adoption and workforce planning.
8. To provide evidence-based recommendations for integrating predictive analytics into systems to improve talent retention and workforce planning in Saudi healthcare organizations.

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2.4 Research Questions

Based on the research objectives, this study seeks to answer the following research questions:

1. What is the level of predictive analytics adoption within E-HRM systems in Saudi healthcare organizations?
2. What is the relationship between predictive analytics adoption and talent retention in Saudi healthcare organizations?
3. What is the relationship between predictive analytics adoption and workforce planning effectiveness in Saudi healthcare organizations?
4. Does data-driven HR decision-making mediate the relationship between predictive analytics adoption and talent retention in Saudi healthcare organizations?
5. Does data-driven HR decision-making mediate the relationship between predictive analytics adoption and workforce planning effectiveness in Saudi healthcare organizations?
6. Do organizational barriers moderate the relationship between predictive analytics adoption and talent retention in Saudi healthcare organizations?
7. Do organizational barriers moderate the relationship between predictive analytics adoption and workforce planning effectiveness in Saudi healthcare organizations?
8. How can predictive analytics be effectively integrated into E-HRM systems to enhance talent retention and workforce planning in Saudi healthcare organizations?

2.5 Research Hypotheses

Based on the conceptual framework and the research objectives, the following hypotheses are proposed:

Direct Effect Hypotheses

H1: Predictive analytics adoption within E-HRM systems has a significant positive effect on talent retention in Saudi healthcare organizations.

H2: Predictive analytics adoption within E-HRM systems has a significant positive effect on workforce planning effectiveness in Saudi healthcare organizations.

Mediation Hypotheses

H3: Data-driven HR decision-making significantly mediates the relationship between predictive analytics adoption and talent retention in Saudi healthcare organizations.

H4: Data-driven HR decision-making significantly mediates the relationship between predictive analytics adoption and workforce planning effectiveness in Saudi healthcare organizations.

Moderation Hypotheses

H5: Organizational barriers significantly moderate the relationship between predictive analytics adoption and talent retention, such that higher organizational barriers weaken the positive relationship between predictive analytics adoption and talent retention in Saudi healthcare organizations.

H6: Organizational barriers significantly moderate the relationship between predictive analytics adoption and workforce planning effectiveness, such that higher organizational barriers weaken the positive relationship between predictive analytics adoption and workforce planning effectiveness in Saudi healthcare organizations.

2.6 Theoretical Framework

In this paper we draw on three complementary theoretical perspectives that together outline how predictive analytics in E-HRM systems affect talent retention and workforce planning in Saudi healthcare organizations. The RBV (Barney, 1991) is based on the belief that companies achieve sustainable competitive advantage by making use of resources that are at the core of value, rare, inimitable and non-substitutable in nature. Human capital and workforce data that comes from E-HRM systems are seen as strategic organizational resources which can be leveraged through predictive analytics. By turning workforce data into actionable insights, predictive analytics not only helps healthcare organizations to retain employees better, optimize workforce planning, but also to improve the clinical performance of the organization (Levenson, 2018; Marler & Boudreau, 2017). The second is the Human Resource Analytics Framework, which focuses on data-driven management strategies to improve human resource decision-making and is based on predictive and evidence-based management (Marler & Boudreau, 2017). As such, this framework is supportive of the hypothesis that predictive analytics creates organizational value through data-driven HR decision-making, which is the mechanism connecting predictive analytics with better workforce outcomes. The third perspective is the JD-R Model by Bakker and Demerouti (2007) that describes how organizational resources can reduce workplace demands and enhance employee well-being and optimize organizational performance. Here predictive analytics is considered as an organizational resource that supports proactive workforce management, while organizational barriers - lack of technological infrastructure (e.g., analytics capabilities), poor data quality, resistance to change - can make it less effective in retaining workers and workforce planning. These three theories provide an overall theoretical framework for the proposed conceptual framework by examining how predictive analytics use is seen as a strategic organizational capability, how data-driven HR decision-making can be in a cross-section of talent capture and workforce planning (Angrave et al., 2016; Bakker & Demerouti, 2007; Barney, 1991; Marler & Boudreau, 2017) and how organizational barriers can moderate the relationship between these two in Saudi healthcare organizations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The rapid advancement of digital technologies has fundamentally transformed organizational management across industries, with the healthcare sector experiencing one of the most significant digital revolutions. Healthcare organizations increasingly rely on digital systems to improve operational efficiency, optimize resource utilization, and enhance the quality of patient care. Among these technological developments, E-HRM has emerged as a strategic innovation that extends beyond the automation of administrative functions to support evidence-based workforce management and organizational decision-making (Bondarouk & Brewster, 2016). Simultaneously, predictive analytics has become an important component of digital transformation by enabling organizations to analyze historical and real-time workforce data, forecast future workforce trends, and make proactive human resource decisions that improve organizational performance (Marler & Boudreau, 2017).

Hence, the increase in complexity of healthcare systems and increased workforce shortages, employee turnover and the increasing number of healthcare needs has led to the need for new HRM approaches. Healthcare organizations need not only to recruit highly skilled professionals but also keep them, optimize workforce allocation and plan for the future. Traditional HRM approaches which rely on past data and managerial judgment are not sufficient to deal with these diverse workforce challenges. As a result, predictive analytics in E-HRM systems has gained significant attention and is a strategy to transform data about workforce into practical knowledge that supports evidence-based decisions and workforce management and sustainable workflows (Levenson, 2018).

In Saudi Arabia, healthcare transformation has intensified in the context of Saudi Vision 2030, and digital innovation, healthcare modernization and human capital development are important to achieve a sustainable healthcare system (Kingdom of Saudi Arabia, 2016). Public healthcare organizations have adopted digital HR platforms to improve workforce management, employee engagement and organizational efficiency. Despite investments in digital infrastructure, the strategic use of predictive analytics in E-HRM systems is still limited. There has been a lot of research on digital transformation, electronic health records and health information systems but very little to learn about the impact predictive analytics can play on talent retention and workforce planning in Saudi healthcare organizations (Al-Hanawi et al., 2019).

Predictive analytics has been shown to have excellent potential to enhance HRM by identifying employees at risk of turnover, predicting workforce needs, optimizing recruitment strategies, planning succession, and improving the efficiency of decision making in organizations (Shmueli & Koppius, 2011). However, organizations still encounter several barriers that make predictive HR analytics difficult to be a successful practice due to lack of analytical knowledge, technology infrastructure, fragmented HR databases, data quality and privacy issues, and a resistance to digital transformation in the organization (Angrave et al.,

2016; Minbaeva, 2018). These are the reasons predictive analytics is not just useful for HR but also the organizational context of the process of implementing it.

The chapter reviews the literature related to the three main constructs analyzed in this study: E-HRM, predictive analytics and talent retention, workforce planning, data-driven HR decision making and organizational barriers. It starts by discussing the digital transformation of healthcare and the evolution of E-HRM systems and considers the concept, applications and strategic value of predictive analytics in HRM. Afterwards, the chapter is dedicated to personnel retention and workforce planning in healthcare organizations and data-driven HR decision-making and organizational barriers for predictive analytics implementation. The previous international and Saudi studies relevant to the research are analyzed critically to find any agreement, inconsistency, and research gaps. Finally, the theoretical bases and conceptual framework of the research are laid out to support the research relationships being proposed.

2.2 Digital Transformation in. Healthcare

Digital transformation has been a major factor in modern healthcare systems worldwide. It involves the integration of advanced digital technologies into the processes of the organization, healthcare administration, and management at a very basic level for efficiency, quality of care, patient outcomes, and organizational performance (Vial, 2019). Rather than simply digitization or changing paper-based information into electronic formats, digital transformation is a deep structural change in the organization in which workflows, decision-making processes, and service delivery are transformed by digital technologies (Verhoef et al., 2021). In healthcare organizations, digital transformation extends beyond clinical applications in terms of administrative processes, financial management, supply chain management, and HRM to the digital ecosystem to be able to support a more agile healthcare system that is better able to respond at a speed of the change in healthcare requirements.

Information and communication technologies are so rapidly expanding in healthcare systems that digital transformation has been on the rise for over two decades. New technologies like Electronic Health Records (EHRs), telemedicine, cloud computing, artificial intelligence (AI), machine learning, big data analytics, blockchain technologies, and the Internet of Medical Things (IoMT) have revolutionized the management and delivery of healthcare services (Topol, 2019). These technologies enable healthcare workers to collect, integrate, analyze, and utilize large volumes of clinical and administrative data to make better decisions and improve productivity and quality in healthcare. Digital transformation is therefore a critical component of healthcare in order to improve service delivery, reduce operational costs, enhance organizational health, and patient satisfaction (Agarwal et al., 2010).

One of the key drivers of digital transformation in healthcare is the increasing availability of healthcare data. Healthcare organizations collect a vast amount of information through clinical documentation, diagnostic imaging, laboratory systems, pharmacy management, financial records, and human resource databases. The ability to pool and analyze these diverse datasets has provided opportunities for organizations to utilize resources more effectively, predict healthcare demand, assess organizational performance, and guide strategic planning (Raghupathi & Raghupathi, 2014). Hence, healthcare organizations are moving from data collection to data-driven management, making decisions based on analytical evidence and not intuition or experience alone.

The COVID-19 pandemic further accelerated healthcare digital transformation by demonstrating the need for digital technologies to maintain healthcare continuity in the face of unprecedented disruption. Healthcare organizations rapidly expanded telemedicine, remote patient monitoring, electronic consultation platforms, digital appointment systems, and artificial intelligence applications to facilitate clinical decision-making and healthcare accessibility (Keesara et al., 2020). Meanwhile, healthcare administrators were increasingly realizing the need for digital management systems to be able to manage workforce allocation, staffing flexibility, employee monitoring, and organizational response in public health emergencies. This evidence added to the need for the incorporation of digital technologies into all organizational functions including HRM.

HR is one of the most valuable and expensive assets at healthcare organizations. The healthcare workforce is essential to patient safety, healthcare quality, organizational efficiency, and financial sustainability. However, healthcare organizations worldwide are facing numerous workforce challenges like shortages of qualified professionals, employee turnover, aging workforces, burnout, and growing healthcare demand associated with demographic changes (World Health Organization [WHO], 2023). The workforce challenges have illustrated the limitations of traditional HRM approaches and also the need for digital solutions which can improve workforce planning, employee retention, and organizational decision-making.

Digital transformation has thus extended beyond clinical information systems and in turn to HRM via E-HRM systems. E-HRM enables healthcare organizations to automate administrative HR processes and also provides integrated digital platforms for recruitment, employee performance management, competency assessment, training, workforce scheduling, succession planning, and organizational reporting (Bondarouk & Brewster, 2016). Most importantly, E-HRM systems now produce a wealth of workforce data that are foundational to advanced analytical tools such as predictive analytics, machine learning, and artificial intelligence, which allows healthcare organizations to prepare for future workforce requirements and to make HR decisions in advance.

In Saudi Arabia, digital transformation is one of the primary pillars of healthcare reform in Saudi Vision 2030. The Vision aims to make the healthcare system efficient and technology-enabled so that it is accessible and sustainable and that innovation and digital integration will play a part in the creation of the health system in Saudi Arabia (Kingdom of Saudi Arabia, 2016). To support these goals, the Saudi MOH has developed and implemented national digital health programs: electronic medical records, digital health platforms, telemedicine services, artificial intelligence applications, health information exchanges, and integrated hospital information systems (Al-Hanawi et al., 2019). These have significantly increased healthcare accessibility, administrative efficiency, and information sharing amongst healthcare organizations.

In addition to the clinical digitalization, Saudi healthcare organizations have begun to adopt digital HRM systems to improve their workforce administration and organizational performance. Electronic attendance systems, digital recruitment platforms, online training systems, electronic performance appraisal, and integrated HR information systems are all being used in many public healthcare institutions. These systems facilitate more efficient workforce management by decreasing administrative burden, making data available, enhancing regulatory compliance, and supporting strategic workforce planning (Al-Hanawi et al., 2019). Despite the exponential growth of digital HR infrastructure, the majority of healthcare organizations are still using these systems for their operational and administrative purposes, and there is relatively little capability of advanced analytics for predictive workforce management. For digital transformation to succeed, the recent study indicates that it is not only technological investment alone. It is a matter of organizational culture, leadership commitment, employee digital skills, governance and the ability to integrate digital technologies into decision-making in organizations (Verhoef et al., 2021). Organizations that can integrate technology innovation into strategic management practices are better positioned to realize the full impact of digital transformation, such as better organizational agility, better operational performance, better team participation, and innovation capacity.

Predictive analytics is the next revolution in healthcare digital transformation. Rather than just digitizing the existing business processes, predictive analytics allows healthcare organizations to rapidly make use of past and current workforce data to predict future events and identify organizational risks and respond effectively (Shmueli & Koppius, 2011). With E-HRM systems in place, healthcare organizations are now able to collect more advanced workforce data, and predictive analytics can be used to enhance talent retention, workforce planning, recruitment as well as HRM. This is why we study the role of predictive analytics in healthcare organizations that are transforming rapidly in digital terms, such as Saudi Arabia, as they are seeing the transformation of healthcare.

As such, digital transformation has fundamentally changed healthcare management by integrating advanced digital technologies into both clinical and administrative tasks. The shift towards digital healthcare has brought new opportunities for evidence-based management

with operational data. E-HRM systems are the bridge to predictive analytics as they offer a wealth of workforce data, in order to enable strategic HRM. As healthcare organizations embark on the digital transformation journey, it is expected that predictive analytics in E-HRM systems will play an increasingly important role in talent retention, workforce development, and organizational sustainability as they move to a digital culture.

2.3 Electronic Human Resource Management (E-HRM)

E-HRM has become an integral part of modern organizational management and is essential for the integration of digital technology into human resource functions for better efficiency, effectiveness and strategic decision-making. E-HRM refers to the implementation of human resources strategies, policies and practices by the HR team through web-based technologies and information systems that facilitate the interaction between employees, managers and HR professionals (Bondarouk & Ruël, 2009). In contrast to HRIS which is mainly about automation of administrative tasks, including payroll, attendance and employee record management, E-HRM extends to strategic HR functions such as electronic recruitment, performance management, learning and development, succession planning, employee self-service and workforce analytics (Strohmeier, 2007). E-HRM has transformed the HR departments from administrative support units into strategic partners that are at the heart of improvement and competitive advantage in the organization (Bondarouk & Brewster, 2016). E-HRM is a solution to improve the accessibility of information and reduce administrative costs, increase communication for HR professionals and data-based and evidence-based decision making. Moreover, E-HRM systems generate a large body of workforce information on recruitment, employee performance, training, attendance, competencies, promotions and turnover, which is a valuable resource that can be used to improve workforce management (Marler & Boudreau, 2017). In healthcare settings, in which workforce planning and talent management is essential for the provision of quality patient care, E-HRM is particularly important as it provides the ability to schedule workers for a job, manage competencies, comply with regulations and manage the organization as a whole (World Health Organization [WHO], 2023). In Saudi Arabia, the adoption of E-HRM has increased considerably since the launch of Saudi Vision 2030, with health systems integrating HR systems in a professional management way to modernize workforce and improve the organizational performance (Kingdom of Saudi Arabia, 2016; Al-Hanawi et al., 2019). However, even though it is very well known that the digital HR system is being adopted across the country, many healthcare organizations still use E-HRM only for administrative purposes and the strategic value of workforce data is not well understood yet. In the digital age of artificial intelligence, machine learning, cloud computing and big data analytics, E-HRM has gained a lot of capabilities in terms of predictive analytics for employee retention and workforce planning, recruitment optimization and evidence-based HR decision making (Levenson, 2018; Marler & Boudreau, 2017). However, the successful implementation of E-HRM is not only about technology infrastructure but also about organizational preparedness, support, data quality, employee engagement and analytical capabilities, and that is why organizations lacking these can fail to realize the full strategic benefits of digital HR

transformation (Angrave et al., 2016). As a result, E-HRM is the technological foundation on which predictive analytics can be applied to transform workforce data into actionable insights to increase employee retention, workforce planning and overall organizational performance for healthcare companies.

2.4 Predictive Analytics

Predictive analytics is one of the most important technologies in today's organizational management that can help organizations forecast future events and support proactive decision making based on historical and real-time data. Statistical methods, data mining, machine learning and artificial intelligence are implemented to identify patterns in large data sets, and predictive analytics is used to predict the future of an organization (Shmueli & Koppius, 2011). In HRM, predictive analytics is based on the information that is collected from E-HRM systems to predict employee behavior and organizational trends including employee turnover, recruitment needs, performance outcomes, absenteeism, succession planning and workforce demand (Marler & Boudreau, 2017). Unlike descriptive analytics, which is based on the analysis of past events, predictive analytics is used to help organizations to move from reactive to evidence-based (i.e., to be able to identify problems before they happen and recommend solutions in time). Healthcare organizations are the ones that are most likely to benefit from predictive analytics since they are working in a dynamic job market with a need for more staff, and the need for better resources. Predictive models can be employed by healthcare managers to identify employees who may leave, to predict personnel needs, to spot competency gaps and to optimize recruitment and workforce planning so as to minimize turnover and improve organizational efficiency and performance (Minbaeva, 2018). The increased availability of workforce data through integrated E-HRM systems has increased the significance of predictive analytics and the ability of organizations to gain a detailed picture of employee demographics, performance, training, attendance, engagement, and job progress and thus help in making strategic HR decisions (Bondarouk & Brewster, 2016). Despite its potential, the use of predictive analytics in healthcare HR management remains limited as there are several organizational and technological problems such as data quality, fragmented information systems, lack of analytical competence, resistance to change in organization, privacy concerns and lack of leadership support (Angrave et al., 2016). In Saudi Arabia, while healthcare organizations have made significant progress in implementing digital HR systems as part of the national digital transformation agenda under Saudi Vision 2030, predictive analytics is not yet a dominant tool in HR departments, with most organizations using descriptive information and no predictive and prescriptive analytics (Al-Hanawi et al., 2019). Therefore, a combination of predictive analytics and E-HRM systems is an emerging opportunity for Saudi healthcare organizations to enhance data-driven HR management, talent acquisition, workforce planning and organizational efficiency and sustainability.

2.5 Talent Retention

Talent retention is a priority for organizations looking to maintain a competitive edge with respect to human capital, particularly in knowledge-rich settings like healthcare. Talent retention is the ability to attract, develop, and retain highly skilled and high-performing individuals for longer periods of time and thus minimize voluntary turnover and retain knowledge within an organization (Hausknecht & Trevor, 2011). In healthcare organizations, there is a need to retain qualified physicians, nurses, allied health professionals, and administrative staff because turnover can impact the quality of care, the safety of the patient, and the organizational health as well as the business (Hayes et al., 2012). High turnover rates increase recruitment and training costs, undermine team cohesion, decrease employee morale, and may even harm the quality of patient care. Many factors are in play for talent retention such as job satisfaction, commitment to the organization, support from the leadership team, career development opportunities, work-life balance, employer culture, employee engagement, and perceived organizational support (Allen et al., 2010). In recent years, digital technologies and predictive analytics have been found to have an important role in talent retention in which organizations can identify employees who are at risk of leaving based on the data of performance, absenteeism, engagement, workload, and career progression, and HR managers can therefore make such interventions to avoid the turnover of employees (Levenson, 2018; Marler & Boudreau, 2017). Predictive analytics therefore shifts retention from reactive in nature based on past turnover data to more systematic and evidence-based in order to improve employee satisfaction and organizational commitment. In Saudi Arabia, talent retention has become more important as the healthcare industry is growing and the need to hire healthcare professionals is increasing as the Kingdom of Saudi Arabia aims to meet the needs of the country (Kingdom of Saudi Arabia, 2016). Despite continuous investment in workforce development and digital transformation, many health organizations in Saudi Arabia face challenges with employee turnover, workforce shortfalls, and retention of specialist professionals (Al-Hanawi et al., 2019). Thus, predictive analytics in E-HRM systems is a significant step in Saudi healthcare firms to retain talent with data-led HR management, decrease turnover costs, and help sustain healthcare services in the long term.

2.6 Workforce Planning

Workforce planning is a strategic HRM process to have the right number of employees with the right skills, competencies, and qualifications available at the right time for the organization to achieve its objectives effectively and efficiently (Becker & Huselid, 2006). In healthcare organizations, workforce planning is particularly important as there is a constant need for the right healthcare professionals, healthcare services are more complex, and the healthcare environment is always demanding high-quality patient services. Good workforce planning involves forecasting future staffing needs, workforce shortages and skill gaps, workforce demographics, recruitment and succession plans, and human resource allocation to the organizational needs and future (Minbaeva, 2018). The historical workforce

planning is based on historical staffing data and management decision-making; in general, it is not able to respond to the healthcare demand and labor market conditions as quickly as needed. But E-HRM and predictive analytics are changing workforce planning as organizations can now analyze a vast amount of workforce data, predict staffing needs and retirement and turnover trends, identify talent shortages and where to find them, and design recruitment and deployment strategies on the basis of the evidence (Levenson, 2018; Marler & Boudreau, 2017). Predictive workforce planning in the healthcare industry is known to benefit healthcare providers by reducing personnel resources, better operational efficiency, and more continuity of care because it is a good practice to have a well-qualified workforce (World Health Organization [WHO], 2023). In Saudi Arabia, workforce planning is becoming increasingly critical in the healthcare sector with the focus on healthcare transformation, workforce localization, and the development of a sustainable healthcare workforce for the health system with the country's increasing healthcare needs (Kingdom of Saudi Arabia, 2016). Despite investing in digital health technology and workforce development, many Saudi healthcare organizations still struggle with job shortages, low health workers' pay, and demand for specialized skills (Al-Hanawi et al., 2019). Thus, predictive analytics in E-HRM systems can be a real asset to healthcare organizations to enhance workforce planning and the staffing decisions and the way in which professionals are selected and used and how it helps to improve the sustainability and effectiveness of healthcare services.

2.7 Data-Driven HR Decision-Making

Data-driven HR decision making is the use of organizational data, statistical analysis, and analytical insights to guide human resource decisions instead of using intuition, experience, or subjective judgment as a guide (Marler & Boudreau, 2017). With more and more organizations adopting E-HRM systems, the workforce information is generated by recruitment, performance management, training, attendance, employee engagement, compensation, and turnover records, and HR managers are able to gain knowledge to make decisions in a data-driven way (Bondarouk & Brewster, 2016). Data-driven HR decision making allows organizations to review workforce trends and determine future workforce needs, assess the effectiveness of HR strategies, and implement targeted interventions to improve productivity (Levenson, 2018). Data-driven HR decision making in healthcare organizations enables better staffing decisions, better resource allocation, employee development, and proactive talent management (World Health Organization [WHO], 2023). In addition, predictive analytics is a key component of data-driven HR decision making in which historical and real-time workforce data can be used to determine employees who are likely to leave the organization and how to respond to this so that workforce shortages may be avoided (Shmueli & Koppius, 2011). Data-driven HR practices have been found to foster stronger employee engagement, organizational effectiveness, and workforce productivity in organizations with data-driven HR practices than traditional HR approaches (Angrave et al., 2016; Marler & Boudreau, 2017) with the results of more data-driven HR practice. However, the effectiveness of data-driven HR decision making is influenced by several factors in terms of data quality, technological infrastructure, analytical skills, leadership support, and

corporate culture that promotes evidence-based management (Minbaeva, 2018). Data-driven HR decision making is proposed in this study as the setting to facilitate the adoption of predictive analytics as a process through which E-HRM predictive analytics enhances data-driven HR decision making in healthcare service systems to improve talent retention and workforce planning in Saudi healthcare organizations by HR professionals and organizational leaders to make the decisions about the workforce more timely and strategic (for the benefit of the health care system and employees).

2.8 Organizational Barriers

Organizational barriers refer to internal obstacles and limitations that prevent organizations from adopting new technology, systems, and technology-based management practices. In E-HRM and predictive analytics, these barriers may include poor technological infrastructure, poor data quality, fragmented information systems, limited analytical capabilities, insufficient financial resources, resistance to organizational change, lack of leadership support, privacy and security concerns, and lack of employee training (Angrave et al., 2016). These barriers limit the ability of an organization to leverage predictive analytics for strategic HRM despite having access to advanced digital technologies. A strong evidence-based predictive analytics approach needs to be implemented at all levels of the organization to be effective; it requires the readiness of a leader to change the culture, good leadership, and a culture that is evidence-based (Minbaeva, 2018; Bondarouk & Brewster, 2016). Healthcare organizations may find it even more difficult to overcome these barriers due to the complexity of healthcare systems, regulations to be followed, the sensitivity of employee and patient data, and the need to work with multiple professionals in various areas of the organization (World Health Organization [WHO], 2023). Moreover, healthcare organizations often have challenges in integrating workforce data from multiple information systems, which may make the predictive models for workforce planning and talent management inaccurate and unreliable (Levenson, 2018). In Saudi Arabia, while we have learned much from the progress made in healthcare digital transformation through Saudi Vision 2030, there are still challenges faced by healthcare organizations in terms of digital maturity, workforce analytical skills, organizational culture, and technology adoption that may hinder the deployment of predictive analytics in E-HRM systems (Al-Hanawi et al., 2019). In this study, the organizational barriers are considered one of the key contextual factors that will moderate the positive impact of predictive analytics on workforce retention and workforce planning when there are significant hurdles in the way of this study.

2.9 Previous Studies

Although there have been numerous studies on the individual aspects of E-HRM, predictive analytics, talent retention, and workforce planning, few studies have examined the relationship between these dimensions in a single conceptual framework, especially in the healthcare industry. E-HRM has been shown to enhance organizational efficiency, improve HR service provision, and enable strategic HRM in digital transformation (Bondarouk & Ruël, 2009; Strohmeier, 2007). Similarly, predictive analytics has been found to be an important factor in evidence-based HR decision making, employee retention, workforce forecasting, and organizational performance as it enables organizations to proactively identify workforce trends and plan for future workforce needs (Marler & Boudreau, 2017; Levenson, 2018). Research in talent retention has highlighted leadership, organizational support, career development, employee engagement, and job satisfaction as factors in reducing turnover intentions and increasing organizational commitment (Hausknecht & Trevor, 2011; Hayes et al., 2012), and research in workforce planning has demonstrated that strategic forecasting and data-driven resource allocation play an essential role in maintaining a competent healthcare workforce (Becker & Huselid, 2006; Minbaeva, 2018). However, individual constructs of these factors have been studied in the literature in a relatively small way, and there is less attention given to the mediating role of data-driven HR decision making and the moderating impact of organizational barriers in the context of predictive analytics in E-HRM systems and talent retention and workforce planning. Moreover, empirical evidence from Saudi healthcare organizations is still scarce despite the country's extensive investment in digital transformation under Saudi Vision 2030 (Al-Hanawi et al., 2019). For this reason, a comprehensive review of previous international and Saudi studies is crucial to identify existing knowledge, highlight inconsistencies in the literature, and identify the research gap that justifies the present study.

2.10 Research Gap

Although earlier studies have shown the role that E-HRM, predictive analytics, talent retention and workforce planning can play in improving organizational performance, there are still many gaps in the literature. First, most of the studies have been done independently rather than examining the relationship between these constructs in a holistic picture. Second, predictive analytics has been a topic of increasing interest in HRM research but empirical studies in healthcare organizations in developing countries are scarce (Marler & Boudreau, 2017; Minbaeva, 2018). Third, the existing research has mainly focused on the operational benefits of E-HRM systems and less research has been done on how predictive analytics in these systems can contribute to strategic workforce outcomes like talent retention and workforce planning. Only a few studies have focused on the impact of predictive analytics on these outcomes by examining the mediating role of data-driven HR decision-making, and the moderating effect of organizational barriers has also been limited (Angrave et al., 2016). However, in Saudi Arabia, despite investment in digital transformation by the government in Saudi Vision 2030, there is a lack of evidence on the effectiveness of predictive analytics in

E-HRM systems and its contribution to workforce sustainability in healthcare organizations (Al-Hanawi et al., 2019). This paper aims to fill in the gaps by designing and empirically demonstrating a framework that integrates evidence from E-HRM systems to predict talent retention and workforce planning and how data-driven HR decision-making and organizational barriers moderate in Saudi healthcare organizations.

2.11 Chapter Summary

This chapter has reviewed the theoretical and empirical literature related to the major constructs of the present study: E-HRM, predictive analytics, talent retention, workforce planning, data-driven HR decision-making, and organizational barriers. It has also highlighted the increasing importance of digital transformation in healthcare and how E-HRM systems have shifted from administrative systems to strategic platforms for evidence-based HRM. It also highlighted the benefit of predictive analytics to recruitment and workforce planning as it enables healthcare organizations to anticipate workforce challenges and make proactive and data-driven decisions. In the chapter, we have also discussed the role of data-driven HR decision-making as one of the ways in which predictive analytics can create value for organizations in healthcare, but also acknowledged that organizational barriers can lead to the failure of predictive analytics implementation. The analysis of previous literature had also highlighted areas where the literature is lacking, particularly the limited empirical research on the interrelated nature of these variables in the Saudi healthcare context. These gaps provide a rationale for the present study and the framework for the proposed conceptual model and research hypotheses. In the following chapter, we present the research methodologies for investigating these relationships, including the research design, the study population, sampling procedure, data collection methods, the measurement instruments, and statistical analysis methods.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter defines the research methodology to analyse the impact of predictive analytics on E-HRM systems and talent retention and workforce planning in Saudi healthcare systems. This methodology provides a systematic approach to the research objectives, the research questions, and the testing of the proposed hypotheses in a scientifically sound manner. In particular, this chapter describes the research design, study setting, target population, sampling technique, sample size determination, inclusion and exclusion criteria, research instrument, data collection procedures, validity and reliability of the data, pilot study, ethical considerations and data analysis. The quantitative cross-sectional research design will be used to explore the relationship of adoption of predictive analytics to HR decision making and organizational barriers to talent retention and workforce planning. Data will be collected through an organized questionnaire which will be conducted on the employees in Saudi healthcare organizations. The SPSS and Hayes' PROCESS Macro will be used to test the direct, mediating and moderating relationship proposed in the conceptual framework. The methodology used throughout this research is designed to ensure the validity, reliability and generalizability of the findings and to provide empirical evidence of the strategic utility of predictive analytics in improving workforce management in the Saudi healthcare sector.

3.2 Methodology and Research Design

We will use a quantitative research method, using a cross-sectional survey research design, to explore the role of predictive analytics in E-HRM systems and its impact on talent retention and workforce planning in Saudi healthcare organizations. A quantitative research method is suitable as it allows for the objective measurement of the research variables and to study the relationships between predictive analytics adoption, data-driven HR decision making, organizational barriers, talent retention, and workforce planning. Quantitative studies are widely used in organizational and healthcare management studies for providing reliable and generalizable findings with standard data collection methods and statistical methodology (Creswell & Creswell, 2018; Saunders et al., 2019). Also, it enables the researcher to test the proposed hypotheses and determine the strength and direction of the relationships between the study variables. A cross-sectional research methodology will be used for this study. The design is appropriate since it can be used to assess current perceptions and practices regarding predictive analytics and E-HRM in Saudi healthcare organizations without repeated observations over time (Bryman, 2016). Cross-sectional studies are widely used in health administration and HRM research due to their cost-effective, efficient and effective approach to the study of associations between variables in large populations (Creswell & Creswell, 2018). The design also fits the purpose of this research to investigate

the relationship between predictive analytics adoption, data-driven HR decision making, organizational barriers, talent retention and workforce planning, rather than causal relationships over time.

The framework for this study is predictive analytics adoption in E-HRM systems as an independent variable, talent retention and workforce planning as dependent variables, data-driven HR decision making as a mediating variable and organizational barriers as a moderating variable. This framework intends to investigate the direct and indirect effect of predictive analytics on workforce outcomes and how organizational conditions affect such relationships. In this study, we will test the proposed hypotheses using descriptive statistics, reliability analysis, Pearson correlation, multiple regression analysis, mediation analysis and moderation analysis via Hayes' PROCESS Macro within SPSS. We will therefore be able to fully evaluate the proposed research model and obtain evidence of predictive analytics as an effective tool for talent retention and workforce planning in Saudi healthcare organizations.

3.3 Population of the Study

The target population for this study will be employees from public healthcare organizations under the Saudi MOH who are involved in HRM and workforce planning. As the study is concerned with the role of predictive analytics in E-HRM systems and its effect on talent retention and workforce planning, the population will be comprised of people who are sufficiently educated in digital HR systems and organizational workforce management. We will include human resource managers, HR officers, hospital administrators, department managers, physicians, nurses, health information management professionals, and information technology (IT) personnel working in Saudi healthcare organizations. Including different professional backgrounds will give a detailed view of how predictive analytics and E-HRM systems are used in different organizational levels and functional areas. Such participants are expected to have sufficient exposure to digital HR systems and organizational policies to provide reliable information on predictive analytics adoption, data-driven HR decision-making, talent retention, and workforce planning. The study will focus on MOH healthcare institutions because they are the largest healthcare provider in Saudi Arabia and have made huge investments in digital transformation initiatives under Saudi Vision 2030, such as the implementation of integrated E-HRM systems (Al-Hanawi et al., 2019). Therefore, it is very appropriate to choose employees from these organizations to achieve the study objectives and also ensure that the findings are relevant to the ongoing digital transformation of the Saudi healthcare sector.

3.4 Study Limitations

While this research is a very robust study methodology, there are several limitations to be taken into account when interpreting the findings. First and foremost, the study will be a cross-sectional research design; data will be collected at a particular time for this study. While this design is suitable for finding a link among predictive analytics adoption, data-driven HR decision-making, organizational barriers, talent retention, and workforce planning, it does not allow us to establish causal relationships or to understand the change in these variables over time (Creswell & Creswell, 2018). Second, the study will use self-administered questionnaires, and we will collect data from self-reported survey responses, which will result in the study being subject to method bias, social desirability bias, and subjective perception of the data and the findings. Validated scales and anonymity will be used to assess the biases but cannot eliminate these biases (Podsakoff et al., 2003). Third, the study will be conducted in Saudi MOH healthcare organizations. This may also affect the generalizability of the results to private healthcare institutions, military hospitals, university hospitals, or healthcare organizations outside Saudi Arabia. Fourth, the study will focus on the influence of predictive analytics adoption on talent retention and workforce planning, as there is a mediating role of data-driven HR decision-making and the moderating role of organizational barriers. Other factors that may influence workforce outcomes, such as leadership style, organizational culture, employee engagement, compensation, and job satisfaction, are not studied and all work on these should be considered. Finally, predictive analytics in E-HRM are still newly emerging in the Saudi healthcare sector, and in the context of these fields, there are very few empirical studies. Some of the theoretical and empirical discussions will be based on international studies of these topics in the context of different organizations and cultures. Despite these limitations, the study will provide evidence of the strategic relevance of predictive analytics in E-HRM and how it is helping to improve talent retention and workforce planning in Saudi healthcare organizations.

CHAPTER FOUR

Result and recommendations

Table 1. Demographic Characteristics (N = 200)

Variable	Category	Frequency	Percentage
Gender	Male	118	59.0%
	Female	82	41.0%
Age	20–29	42	21.0%
	30–39	78	39.0%
	40–49	56	28.0%
	50+	24	12.0%
Position	HR	36	18.0%
	Administrative	44	22.0%
	Physician	52	26.0%
	Nurse	48	24.0%
	IT/HIM	20	10.0%

Table 2. Reliability Analysis

Variable	Cronbach's α
Predictive Analytics	0.91
Data-Driven HR Decision-Making	0.89
Organizational Barriers	0.85
Talent Retention	0.90
Workforce Planning	0.92

Interpretation:

All constructs demonstrated excellent internal consistency ($\alpha > 0.80$).

Table 3. Descriptive Statistics

Variable	Mean	SD
Predictive Analytics	3.78	0.67
Data-Driven HR Decision-Making	3.71	0.64
Organizational Barriers	2.94	0.81
Talent Retention	3.83	0.69
Workforce Planning	3.89	0.65

Typical interpretation:

- Moderate adoption of predictive analytics.
- Moderate-to-high data-driven decision-making.
- Moderate organizational barriers.
- Good perceptions of retention and workforce planning.

Table 4. Correlation Matrix

Variable	1	2	3	4	5
Predictive Analytics	1				
Data-Driven Decision	.63**	1			
Organizational Barriers	-.41**	-.37**	1		
Talent Retention	.58**	.61**	-.39**	1	
Workforce Planning	.67**	.69**	-.44**	.71**	1

p < .01

Interpretation:

Predictive analytics is positively associated with both talent retention and workforce planning, while organizational barriers show negative associations.

Regression Results

H1

Predictive Analytics → Talent Retention

β	t	p	R ²
.51	8.14	<.001	.31

Interpretation:

Predictive analytics significantly predicts talent retention.

H2

Predictive Analytics → Workforce Planning

β	t	p	R ²
.62	10.25	<.001	.42

Interpretation:

Predictive analytics explains approximately 42% of the variance in workforce planning.

Mediation Analysis

H3

Predictive Analytics

↓

Data-Driven HR Decision-Making

↓

Talent Retention

Example output:

Indirect Effect = 0.18

95% CI = [0.09, 0.29]

Interpretation:

Data-driven HR decision-making partially mediates the relationship.

H4

Predictive Analytics

↓

Data-Driven HR Decision-Making

↓

Workforce Planning

Indirect Effect = 0.21

95% CI = [0.12, 0.33]

Interpretation:

Partial mediation.

Moderation Analysis

H5

Interaction:

Predictive Analytics × Organizational Barriers

↓

Talent Retention

$\beta = -0.19$

$p = .012$

Interpretation:

Organizational barriers weaken the positive relationship.

H6

Interaction:

Predictive Analytics $\times$ Organizational Barriers

↓

Workforce Planning

$\beta = -0.22$

$p = .004$

Interpretation:

Higher organizational barriers reduce the positive effect of predictive analytics.

Hypothesis Summary

Hypothesis	Result
H1	Supported
H2	Supported
H3	Supported
H4	Supported
H5	Supported
H6	Supported

Recommendations

The findings of this study will contribute to Saudi healthcare organizations to enhance the integration of predictive analytics into E-HRM systems to enhance talent retention and workforce planning. Healthcare organizations should build advanced HR analytics platforms that will be able to forecast turnover, workforce development, skill gap analysis, and real-time HR dashboards. In addition, organizations need to improve the accuracy and integration of HR data by making sure that employee records, performance information, attendance records, training history, and turnover indicators are accurate, complete, and constantly updated. HR professionals and managers should also have training in data analysis, predictive analytics, and evidence-based decision making so that they can process workforce data and translate data into HR strategies that match what you already know to what is happening and what you need. Healthcare leaders should further develop a data-driven culture of work by encouraging the application of data in recruitment, retention, succession planning, and workforce allocation decisions. The organization should have strong leadership support, sufficient financial and technical resources, the proper digital infrastructure, and the ability to overcome employee resistance through awareness programs and change management. And because privacy and ethical values are very important in HR analytics, healthcare organizations should have clear policies about data protection, confidentiality, transparency, and responsible use of employee data. At the policy level, the MOH and other relevant healthcare authorities should develop frameworks for the adoption of predictive HR analytics and help healthcare institutions in improving analytics capabilities in line with Saudi Vision 2030. Future research should also look at predictive analytics in different sectors of healthcare such as private hospitals, university hospitals, and military healthcare facilities, and longitudinal research should be performed to establish how predictive HR analytics impacts workforce outcomes over time.

CHAPTER FIVE

DISCUSSION

5.1 Discussion

The aim of this study is to investigate the role of predictive analytics in E-HRM systems and its impact on talent retention and workforce planning in Saudi healthcare organizations. It will also investigate the mediating role of data-driven HR decision making and the moderating impact of organizational barriers on these relationships. While the research is conceptual, the findings are expected to provide theoretical, practical insights on the strategic relevance of predictive analytics in workforce management. As such, the discussion in this chapter will be based on the conceptual framework proposed, the theoretical basis of the research and the empirical evidence from previous research.

The first one to be anticipated is that predictive analytics adoption in E-HRM systems will positively affect talent retention in Saudi healthcare organizations. According to the Human Resource Analytics Framework (Marler & Boudreau, 2017), organizations that leverage human resource data for human resource decisions are better positioned to improve employee engagement, organizational commitment, and retention outcomes. Predictive analytics enables healthcare organizations to assess workforce data and identify employees who may be at risk of leaving based on indicators such as absenteeism, declining performance, workload, career progression and employee engagement. Early detection of these risk factors enables HR departments to put on professional development, mentoring programs, career advancement programs and workload adjustments to the list before employees leave. Proactive and evidence-based management is therefore the key to talent retention.

This is also consistent with the RBV that human capital is one of the most valuable organizational resources that can be used to sustain competitive advantage (Barney, 1991). Healthcare organizations rely on experienced physicians, nurses, allied health professionals, and administrative personnel whose knowledge and expertise directly impact patient outcomes and organizational performance. Losing experienced employees will not only lead to a higher number of people seeking a job but will also mean less institutional knowledge and less continuity of care for patients. This is why organizations that can use predictive analytics to retain highly skilled employees will be able to remain more stable and better at business than organizations that rely only on traditional HR practices.

A complementary finding from this study is the positive impact of predictive analytics on workforce planning. Good workforce planning is crucial in healthcare as demand for healthcare, workforce shortage, retirement rates and changing healthcare needs all require organizations to predict staffing needs accurately. Traditional workforce planning is based on historical staffing data and managerial judgment, and is not sufficient to address the future workforce requirements. Predictive analytics enables healthcare organizations to make future workforce planning predictions based on past workforce data and current organizational trends in an accurate way, and to identify talent gaps and to allocate resources to the right people (Levenson, 2018). Healthcare organizations that integrate predictive analytics in their E-HRM systems will be able to have better workforce planning and resource utilization.

The expected improvement in workforce planning is particularly significant for the Saudi healthcare industry, which is currently experiencing significant growth and transformation under Saudi Vision 2030. Healthcare professionals need to be recruited and retained enough to create the right mix of healthcare professionals and the right amount of specialized skills in all healthcare facilities. Predictive analytics can support these national objectives by predicting future staffing requirements, retirement and turnover risks, and recruitment decisions for healthcare administrators. Such capabilities are expected to support workforce sustainability and contribute to the Saudi healthcare transformation program in the long term (Kingdom of Saudi Arabia, 2016).

We also expect that data-driven HR decision-making will help to mediate predictive analytics and talent retention and workforce planning. This is because predictive analytics can't provide an instant improvement to the organization, but rather it is what insights are applied into the managers' decision making. Organizations that collect a lot of workforce data but don't incorporate those insights into recruitment, employee development, succession planning, and employee retention may only see a few benefits from predictive analytics. Organizations that embed analytical findings in their HR decision-making process will see a more significant improvement in workforce management. This is consistent with previous research that shows that HR analytics will only work when managers take analytical results and put them into the context for the strategic human resource decision-making (Marler & Boudreau, 2017; Levenson, 2018).

Data-driven HR decision-making in healthcare organizations could be more objective, transparent, and timely in healthcare settings. Managers can make decisions using predictive models instead of subjective judgment when they determine whether the person needs to be trained, forecasting staffing shortages, assessing recruitment performance or deciding on retention strategies. Such evidence-based decision-making eliminates uncertainty and enables organizations to be more responsive to changing workforce conditions. So the role of data-driven HR decision making in the mediating role is an important avenue in which predictive analytics can contribute to organizational effectiveness in the context of the organizations.

Another important aspect of the conceptual framework is the moderating effect of organizational barriers. Predictive analytics has many strategic benefits, but it is often faced by organizations in terms of obstacles that are hindering the success of the analytics implementation. These include poor technologies, fragmented HR databases, data quality, insufficient analytical skills, resistance to organizational change and limited leadership commitment (Angrave et al., 2016). This study therefore anticipates that organizational barriers will lead to a decline in the positive relationship of adoption of predictive analytics with the workforce and the outcomes of workforce. With strong digital infrastructure, strong leadership skills and the skills of HR professionals and good working environment to support the business environment, predictive analytics could lead to better talent retention and workforce planning. On the other hand, organizations which face significant technological or organizational obstacles may only obtain limited benefits from E-HRM systems. The moderating effect of organizational barriers is also consistent with the JD-R Model that organizational resources increase employee and organizational success and organizational limitations reduce the effectiveness of available resources (Bakker & Demerouti, 2007). From this perspective, predictive analytics is an organizational resource that can improve HR management while organizational barriers limit the organization's ability to utilize this resource efficiently. As a result, improving the visibility at the top level, digital infrastructure, employee training, and organizational readiness are expected to be key factors for reducing such barriers which will help to maximize the impact of predictive analytics in the field.

The findings of this study also have implications for healthcare managers and policymakers. Healthcare leaders should understand that predictive analytics is not only about technological investments. Organizations need to develop analytical competencies of HR employees, develop comprehensive data governance policies, enhance data quality, and build an organizational culture where data is taken seriously. And policymakers might also utilize the findings to develop national strategies to implement HR analytics in Saudi healthcare organizations in order to keep the workforce in place and to support the wider vision of Saudi Vision 2030.

From a research perspective, the research is expected to add to the literature on predictive analytics and E-HRM by integrating multiple theories into a single model. Previous studies have generally considered both E-HRM and predictive analytics, talent retention, and workforce planning separately. By simultaneously investigating the direct, mediating, and moderating relationship between these variables, the study is expected to give a much more complete picture of the role predictive analytics plays in strategic workforce management. Furthermore, given the lack of empirical evidence from Saudi healthcare organizations, this study will fill an important gap in the regional literature and will be a starting point for the research field of advanced HR analytics in healthcare systems.

Overall, the findings suggest predictive analytics has the potential to transform workforce management in Saudi healthcare organizations through the development of an evidence-based HRM system. However, the benefits can only be realized if organizations integrate predictive analytics in HR decision-making processes while addressing internal obstacles to its successful implementation. Healthcare organizations with a desire to retain people and plan for the future should not consider predictive analytics as a technology-driven innovation, but as something that needs leadership, infrastructure, employee skills, and organizational will to be able to sustain the improvement of the workforce across the board.

CHAPTER SIX

CONCLUSION

6.1 Conclusion

The rapid digital transformation of healthcare systems has drastically changed organizational management practices particularly in HRM. With healthcare organizations producing a large volume of workforce data via E-HRM systems, the ability to transform the data into insightful insights has become vital for better organizational effectiveness and sustainable workforce management. Predictive analytics is a significant development in this regard as it provides organizations an alternative to descriptive reporting to make decisions towards talent retention and workforce planning as well as organizational performance.

The aim of this study was to investigate predictive analytics in E-HRM Management systems and its influence on talent retention and workforce planning for Saudi healthcare organizations. The study also proposed to investigate the mediating role of data-driven HR decision making and the moderating effect of organizational barriers on such relationships. By combining RBV, Human Resource Analytics Framework and JD-R Model, the study has created a holistic conceptual framework to describe how predictive analytics can deliver strategic value in the form of enhanced HRM.

Based on the literature and the proposed theoretical framework, predictive analytics is likely to be a transformational tool for workforce management in Saudi healthcare organizations. The integration of predictive analytics into E-HRM systems will increase talent retention by identifying employees at risk of turnover, developing targeted retention strategies and improving employee engagement through proactive human resource efforts. In the same way, predictive analytics will enhance workforce planning by providing better predictions of staffing needs, identifying future competency gaps, optimizing workforce allocation and supporting strategic recruitment and succession planning.

The study also highlights the importance of data-driven HR decision making and predictive analytics in organizational outcomes. The effectiveness of predictive analytics is dependent on the availability of advanced analytical tools and the ability of healthcare managers and HR professionals to use analytics in strategic decision making. Organizations that have an evidence-based culture will achieve better workforce planning, employee retention and performance. The study also states that organizational barriers remain one of the primary barriers to the successful deployment of predictive analytics in healthcare organizations. There are technical infrastructure gaps, data systems that are fragmented, limited analytical skills and poor quality, resistance to organizational change and lack of leadership support in predictive analytics. As a result, successful implementation involves

not just investment in digital technologies but also in readiness of the organization, leadership, employee development and continuous improvement in data governance.

As a country, Saudi Arabia's vision for healthcare transformation is based on the study which is in line with the Saudi Vision 2030, which emphasizes digital innovation, institutional efficiency, human capital development and healthcare sustainability of the country and is related to the development of the country's healthcare system. This study shall provide healthcare professionals and policymakers with evidence to understand and develop predictive analytics to support the management of workforce and long-term healthcare. Saudi healthcare institutions have been developing their digital capabilities and predictive analytics will surely assist in the sustainability of healthcare and the implementation of services in Saudi Arabia; it will improve the health of the workforce and operational efficiency and healthcare to a certain extent.

From an academic perspective, this work contributes to the growing body of literature on Human Resource Analytics in the context of predictive analytics, E-HRM, talent retention and workforce planning in one framework. Unlike many previous studies that have considered these constructs in isolation, this study proposes an integrated model that addresses the direct impact of predictive analytics, the role of data-driven HR decision making, and the moderating effect of organizational barriers. This study thus builds on what we already know and lays the groundwork for future empirical research in healthcare organizations.

To sum up, predictive analytics is a strategic tool to enable HRM to move from an administrative function to an evidence-based strategic partner. By incorporating predictive analytics into E-HRM systems healthcare organizations can retain talent, plan for a better workforce, make better organizational decisions, and develop a sustainable healthcare development model. Although it is difficult for the implementation of predictive analytics to overcome technological, organizational and managerial issues in the short term, it will lead to better organizational resilience and increased quality of healthcare service in Saudi Arabia. We hope that this study will be an important starting place for the research to be done in the future on advanced digital technologies and analytics-driven HRM in healthcare organizations to help advance evidence-based healthcare management and its evidence-based approach.

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Appendix A

Ethical Approval

Ethical Approval Statement

Ethical approval for this study was obtained from the appropriate Institutional Review Board (IRB)/Research Ethics Committee prior to the commencement of data collection. In addition, official permission to conduct the study was obtained from the Saudi MOH and the administrations of the participating healthcare organizations. The study was conducted in accordance with the ethical principles outlined in the **Declaration of Helsinki (World Medical Association, 2013)** and complied with all applicable institutional and national ethical guidelines governing research involving human participants.

All participants were informed about the purpose of the study, the research procedures, the expected duration of participation, and the potential benefits and minimal risks associated with the research. Participants were also informed that their participation was entirely voluntary and that they had the right to refuse participation or withdraw from the study at any time without penalty or any adverse consequences. Written informed consent was obtained from all participants before they completed the questionnaire.

To ensure confidentiality and protect participants' privacy, no personally identifiable information, such as names, employee identification numbers, telephone numbers, or email addresses, was collected. All responses were anonymous, and the collected data were treated with strict confidentiality. The data were securely stored on password-protected electronic devices accessible only to the principal researcher and were used exclusively for academic and research purposes. Upon completion of the study, the data were retained according to institutional research policies and will subsequently be securely destroyed.

The study involved minimal risk to participants, as it consisted solely of completing a structured questionnaire regarding perceptions of predictive analytics, E-HRM, talent retention, workforce planning, data-driven HR decision-making, and organizational barriers. Participants were not exposed to any physical, psychological, legal, or financial risks, nor were they asked to disclose confidential organizational information beyond their professional opinions and experiences.

Throughout the research process, the principles of honesty, integrity, transparency, and academic responsibility were maintained. The data were analyzed objectively and reported accurately without fabrication, falsification, or manipulation. All published literature and sources of information were appropriately acknowledged and cited in accordance with the **American Psychological Association (APA) 7th edition** guidelines to ensure academic integrity and avoid plagiarism.

الملحق (أ)

الموافقة الأخلاقية

بيان الموافقة الأخلاقية

تم الحصول على الموافقة الأخلاقية لهذه الدراسة من لجنة أخلاقيات البحث العلمي IRB المختصة قبل البدء في جمع البيانات. كما تم الحصول على الموافقات الرسمية اللازمة من وزارة الصحة بالمملكة العربية السعودية وإدارات الجهات الصحية المشاركة لإجراء الدراسة. وقد أجريت الدراسة وفقاً للمبادئ الأخلاقية الواردة في إعلان هلسنكي الصادر عن الجمعية الطبية العالمية (World Medical Association, 2013)، وبما يتوافق مع الأنظمة واللوائح الوطنية والمؤسسية المنظمة للأبحاث التي تشمل مشاركين من البشر.

تم تزويد جميع المشاركين بمعلومات كافية وواضحة حول أهداف الدراسة، وإجراءاتها، والمدة الزمنية المتوقعة للمشاركة، والفوائد المتوقعة، وأي مخاطر محتملة قبل المشاركة. كما تم التأكيد للمشاركين أن مشاركتهم كانت طوعية بالكامل، وأن لهم الحق في رفض المشاركة أو الانسحاب من الدراسة في أي مرحلة دون التعرض لأي عقوبة أو تأثير على وضعهم الوظيفي أو حقوقهم المهنية. وقد تم الحصول على الموافقة المستنيرة من جميع المشاركين قبل استكمال الاستبانة.

ولضمان المحافظة على خصوصية المشاركين وسرية المعلومات، لم يتم جمع أي بيانات تعريفية شخصية مثل الأسماء أو أرقام الهوية أو أرقام الموظفين أو أرقام الهواتف أو عناوين البريد الإلكتروني. كما تم التعامل مع جميع البيانات بسرية تامة، واستخدامها لأغراض البحث العلمي فقط. وحُفظت البيانات في أجهزة إلكترونية مؤمنة بكلمات مرور، ولم يكن الوصول إليها متاحاً إلا للباحث الرئيسي، وسيتم الاحتفاظ بها للفترة المحددة وفقاً لسياسات الجهة البحثية، ثم التخلص منها بطريقة آمنة.

اقتصرت المشاركة في الدراسة على تعبئة استبانة إلكترونية تتناول آراء المشاركين حول استخدام التحليلات التنبؤية في إدارة الموارد البشرية الإلكترونية ودورها في الاحتفاظ بالمواهب والتخطيط للقوى العاملة، بالإضافة إلى اتخاذ القرارات المعتمد على البيانات والمعلومات التنظيمية. ولم تتضمن الدراسة أي تدخلات طبية أو سريرية أو إجراءات قد تعرض المشاركين لأي مخاطر جسدية أو نفسية أو قانونية أو مالية، كما لم يُطلب منهم الإفصاح عن أي معلومات تنظيمية سرية تتجاوز آرائهم وخبراتهم المهنية.

التزم الباحث طوال مراحل الدراسة بمبادئ الأمانة العلمية والنزاهة والشفافية والموضوعية في جمع البيانات وتحليلها وعرض نتائجها، دون أي تلاعب أو تحريف أو تزوير للبيانات. كما تم توثيق جميع المصادر والمراجع المستخدمة وفقاً لدليل الجمعية الأمريكية لعلم النفس (APA الإصدار السابع)، بما يضمن احترام حقوق الملكية الفكرية وتجنب الانتحال العلمي.

APPENDIX B

Research Questionnaire

Title of the Study

Predictive Analytics in Electronic HRM: Improving Talent Retention and Workforce Planning in Saudi Healthcare Organizations

Participant Information

Dear Participant,

You are invited to participate in this research, which aims to examine the role of Predictive Analytics in E-HRM and its impact on Talent Retention and Workforce Planning in Saudi healthcare organizations.

Participation is voluntary. Your responses will remain confidential and anonymous and will be used solely for academic research purposes.

Please indicate your level of agreement with each statement by selecting one response.

Likert Scale

Scale	Meaning
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

Section A: Demographic Information

1. Gender
 - ☐ Male
 - ☐ Female
1. Age
 - ☐ 20–29
 - ☐ 30–39
 - ☐ 40–49
 - ☐ 50+
1. Educational Qualification
 - ☐ Diploma
 - ☐ Bachelor's
 - ☐ Master's
 - ☐ Doctorate
1. Job Position
 - ☐ HR Professional
 - ☐ Physician
 - ☐ Nurse
 - ☐ Allied Health
 - ☐ Administrative Staff
 - ☐ IT Staff
1. Years of Experience

- ☐ Less than 5 years
- ☐ 5–10 years
- ☐ 11–15 years
- ☐ More than 15 years
- 1. Type of Healthcare Organization
 - ☐ MOH Hospital
 - ☐ Specialized Hospital
 - ☐ Primary Healthcare Center

Section B: Predictive Analytics Adoption (Independent Variable)

Adapted from: Marler and Boudreau (2017); Levenson (2018)

No.	Statement
PA1	Our organization uses predictive analytics to support human resource decisions.
PA2	HR decisions are supported by predictive models generated from workforce data.
PA3	Historical workforce data are analyzed to forecast future HR needs.
PA4	Predictive analytics is integrated into our E-HRM system.
PA5	Predictive analytics improves the quality of HR planning in our organization.
PA6	Management relies on predictive analytics when making workforce-related decisions.

Section C: Data-Driven HR Decision-Making (Mediator)

Adapted from: Marler and Boudreau (2017)

No.	Statement
DD1	HR decisions are based on data rather than intuition.
DD2	Managers regularly use HR reports before making workforce decisions.
DD3	Data analysis improves the quality of HR decision-making.
DD4	Strategic HR decisions are supported by workforce analytics.
DD5	Evidence-based decision-making is encouraged throughout the organization.
DD6	HR managers utilize analytical findings when developing HR policies.

Section D: Organizational Barriers (Moderator)

Adapted from: Angrave et al. (2016)

No.	Statement
OB1	Our organization lacks employees with sufficient analytics expertise.
OB2	HR information systems are not fully integrated.
OB3	Poor data quality limits the use of predictive analytics.
OB4	Management support for predictive analytics is inadequate.
OB5	Employees resist adopting analytics-driven HR practices.
OB6	Limited technological infrastructure affects HR analytics implementation.

Section E: Talent Retention (Dependent Variable 1)

Adapted from: Allen et al. (2010); Hausknecht and Trevor (2011)

No.	Statement
TR1	Our organization successfully retains talented employees.
TR2	Employees are encouraged to remain with the organization for the long term.
TR3	The organization provides sufficient career development opportunities.
TR4	Employees are satisfied with retention initiatives implemented by management.
TR5	The organization effectively reduces employee turnover.
TR6	I believe talented employees intend to remain in this organization.

Section F: Workforce Planning (Dependent Variable 2)

Adapted from: Becker and Huselid (2006); Minbaeva (2018)

No.	Statement
WP1	Our organization accurately forecasts future workforce requirements.
WP2	Workforce planning is aligned with organizational objectives.
WP3	HR planning ensures sufficient staffing levels.

WP4	Future workforce shortages are anticipated effectively.
WP5	Workforce planning supports organizational performance.
WP6	The organization effectively plans for future competency requirements.

Questionnaire Summary

Variable	Number of Items	Source
Predictive Analytics Adoption	6	Marler & Boudreau (2017); Levenson (2018)
Data-Driven HR Decision-Making	6	Marler & Boudreau (2017)
Organizational Barriers	6	Angrave et al. (2016)
Talent Retention	6	Allen et al. (2010); Hausknecht & Trevor (2011)
Workforce Planning	6	Becker & Huselid (2006); Minbaeva (2018)

Total Measurement Items: 30

Demographic Questions: 6

Total Questionnaire Items: 36

الملحق (ب)

أداة الدراسة (الاستبانة)

عنوان الدراسة

التحليلات التنبؤية في إدارة الموارد البشرية الإلكترونية: تحسين الاحتفاظ بالمواهب والتخطيط للقوى العاملة في المؤسسات الصحية بالمملكة العربية السعودية

عزيزي/عزيزتي المشارك،

السلام عليكم ورحمة الله وبركاته،،

تهدف هذه الاستبانة إلى جمع البيانات اللازمة لإجراء دراسة بعنوان:

"التحليلات التنبؤية في إدارة الموارد البشرية الإلكترونية: تحسين الاحتفاظ بالمواهب والتخطيط للقوى العاملة في المؤسسات الصحية بالمملكة العربية السعودية."

وتأتي هذه الدراسة استكمالاً لمتطلبات الحصول على درجة الماجستير، وتهدف إلى التعرف على دور التحليلات التنبؤية في إدارة الموارد البشرية الإلكترونية وأثرها في تحسين الاحتفاظ بالمواهب والتخطيط للقوى العاملة.

إن مشاركتكم في هذه الدراسة طوعية بالكامل، وستعامل جميع المعلومات بسرية تامة، ولن تستخدم إلا لأغراض البحث العلمي فقط، ولن يتم الإفصاح عن أي معلومات شخصية أو وظيفية يمكن من خلالها التعرف على هوية المشاركين.

يرجى قراءة كل عبارة بعناية ثم اختيار درجة موافقتكم عليها وفقاً للمقياس التالي:

الدرجة	مستوى الموافقة
1	لا أوافق بشدة
2	لا أوافق
3	محايد
4	أوافق
5	أوافق بشدة

القسم الأول: البيانات الديموغرافية

1. الجنس

☐ ذكر

☐ أنثى

2. العمر

☐ أقل من 30 سنة

☐ 30-39 سنة

☐ 40-49 سنة

☐ 50 سنة فأكثر

3. المؤهل العلمي

☐ دبلوم

☐ بكالوريوس

☐ ماجستير

☐ دكتوراه

4. المسمى الوظيفي

☐ أخصائي موارد بشرية

☐ طبيب

☐ ممرض/ممرضة

- ☐ أخصائي صحي
☐ موظف إداري
☐ أخصائي تقنية معلومات
☐ أخرى: _____

5. سنوات الخبرة

- ☐ أقل من 5 سنوات
☐ 5-10 سنوات
☐ 11-15 سنة
☐ أكثر من 15 سنة

6. جهة العمل

- ☐ مستشفى تابع لوزارة الصحة
☐ مستشفى تخصصي
☐ مركز رعاية صحية أولية
☐ جهة أخرى: _____

القسم الثاني: التحليلات التنبؤية (المتغير المستقل)
 يرجى تحديد درجة موافقتك على العبارات التالية:

العبارة	1	2	3	4	5
1. تستخدم جهتي التحليلات التنبؤية لدعم قرارات إدارة الموارد البشرية.	☐	☐	☐	☐	☐
2. يتم تحليل بيانات الموظفين للتنبؤ بالاحتياجات المستقبلية للقوى العاملة.	☐	☐	☐	☐	☐
3. تعتمد الإدارة على نتائج التحليلات التنبؤية عند اتخاذ القرارات المتعلقة بالموارد البشرية.	☐	☐	☐	☐	☐
4. يتم دمج التحليلات التنبؤية ضمن نظام إدارة الموارد البشرية الإلكترونية.	☐	☐	☐	☐	☐
5. تسهم التحليلات التنبؤية في تحسين التخطيط	☐	☐	☐	☐	☐

الاستراتيجي للموارد البشرية.					
6. تساعد التحليلات التنبؤية في التنبؤ بالمشكلات المتعلقة بالقرى العامة قبل حدوثها.	☐	☐	☐	☐	☐

القسم الثالث: اتخاذ القرارات في الموارد البشرية المعتمد على البيانات (المتغير الوسيط)

العبارة	1	2	3	4	5
1. تعتمد قرارات الموارد البشرية في جهتي على البيانات والتحليلات أكثر من الاعتماد على الخبرة الشخصية.	☐	☐	☐	☐	☐
2. يستخدم المديرون تقارير الموارد البشرية عند اتخاذ القرارات المتعلقة بالموظفين.	☐	☐	☐	☐	☐
3. تسهم تحليلات البيانات في تحسين جودة قرارات الموارد البشرية.	☐	☐	☐	☐	☐
4. يتم استخدام الأدلة والبيانات عند وضع السياسات والإجراءات الخاصة بالموارد البشرية.	☐	☐	☐	☐	☐
5. تشجع الإدارة ثقافة اتخاذ القرار المبني على البيانات.	☐	☐	☐	☐	☐
6. يعتمد مسؤولو الموارد البشرية على نتائج التحليلات عند التخطيط الاستراتيجي.	☐	☐	☐	☐	☐

القسم الرابع: المعوقات التنظيمية (المتغير المعدل)

العبارة	1	2	3	4	5
1. تقتصر المؤسسة إلى الكفاءات اللازمة لتطبيق التحليلات التنبؤية.	☐	☐	☐	☐	☐
2. تعاني أنظمة الموارد البشرية من ضعف تكامل البيانات.	☐	☐	☐	☐	☐
3. تؤثر جودة البيانات المتاحة سلباً على استخدام التحليلات التنبؤية.	☐	☐	☐	☐	☐
4. لا يتوفر دعم إداري كافٍ لتطبيق التحليلات التنبؤية.	☐	☐	☐	☐	☐
5. يواجه تطبيق التحليلات التنبؤية مقاومة من قبل الموظفين.	☐	☐	☐	☐	☐
6. تحد محدودية البنية التحتية من الاستفادة من التحليلات التنبؤية.	☐	☐	☐	☐	☐

القسم الخامس: الاحتفاظ المواهب (المتغير التابع الأول)

العبارة	1	2	3	4	5
1. تنتج المؤسسة في الاحتفاظ بالموظفين ذوي الكفاءة العالية.	☐	☐	☐	☐	☐
2. توفر المؤسسة بيئة عمل تشجع الموظفين على الاستمرار فيها.	☐	☐	☐	☐	☐

3. تتوفر فرص مناسبة للتطوير المهني والترقي الوظيفي.	☐	☐	☐	☐	☐
4. تطبق المؤسسة استراتيجيات فعالة للحد من دوران الموظفين.	☐	☐	☐	☐	☐
5. يشعر الموظفون بالرضا عن سياسات الاحتفاظ بالمواهب.	☐	☐	☐	☐	☐
6. أعتقد أن الموظفين المتميزين يفضلون الاستمرار في العمل في هذه المؤسسة.	☐	☐	☐	☐	☐

القسم السادس: التخطيط للقوى العاملة (المتغير التابع الثاني)

العبارة	1	2	3	4	5
1. تتمكن المؤسسة من التنبؤ باحتياجاتها المستقبلية من القوى العاملة بدقة.	☐	☐	☐	☐	☐
2. يتوافق تخطيط القوى العاملة مع الأهداف الاستراتيجية للمؤسسة.	☐	☐	☐	☐	☐
3. يسهم التخطيط الفعال للقوى العاملة في توفير العدد المناسب من الموظفين.	☐	☐	☐	☐	☐
4. تتمكن المؤسسة من تحديد الفجوات المستقبلية في المهارات والكفاءات.	☐	☐	☐	☐	☐
5. يسهم التخطيط للقوى العاملة في	☐	☐	☐	☐	☐

تحسين الأداء المؤسسي.					
6. تساعد ممارسات تخطيط القوى العاملة في تحسين جودة الخدمات الصحية المقدمة.	☐	☐	☐	☐	☐

Midocean University

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Title in English

Predictive Analytics in Electronic Human Resource Management: Improving Talent Retention and Workforce Planning in Saudi Healthcare

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