Personalized Healthcare Research: Systematic Review with ☸SAIMSARA.

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Abstract: This paper aims to systematically review the current landscape of personalized healthcare research, synthesizing key technological advancements, application areas, and associated challenges as identified in recent literature. The review utilises 1882 studies with 380011 total participants (naïve ΣN). AI-driven diagnostic agents and systems demonstrate a median diagnostic accuracy of 95.4% (range: 85-98.18%) across various healthcare applications, suggesting significant potential for enhancing precision in personalized care. This broad potential extends across diverse conditions and populations, promising more tailored and effective healthcare solutions. However, the Lack of Standardized Study Designs in much of the current literature significantly limits the certainty and generalizability of these promising findings. Therefore, continued investment in developing robust ethical AI frameworks and conducting large-scale, rigorously designed clinical trials is essential to translate these technological advancements into equitable and impactful personalized healthcare practices.

Review Stats

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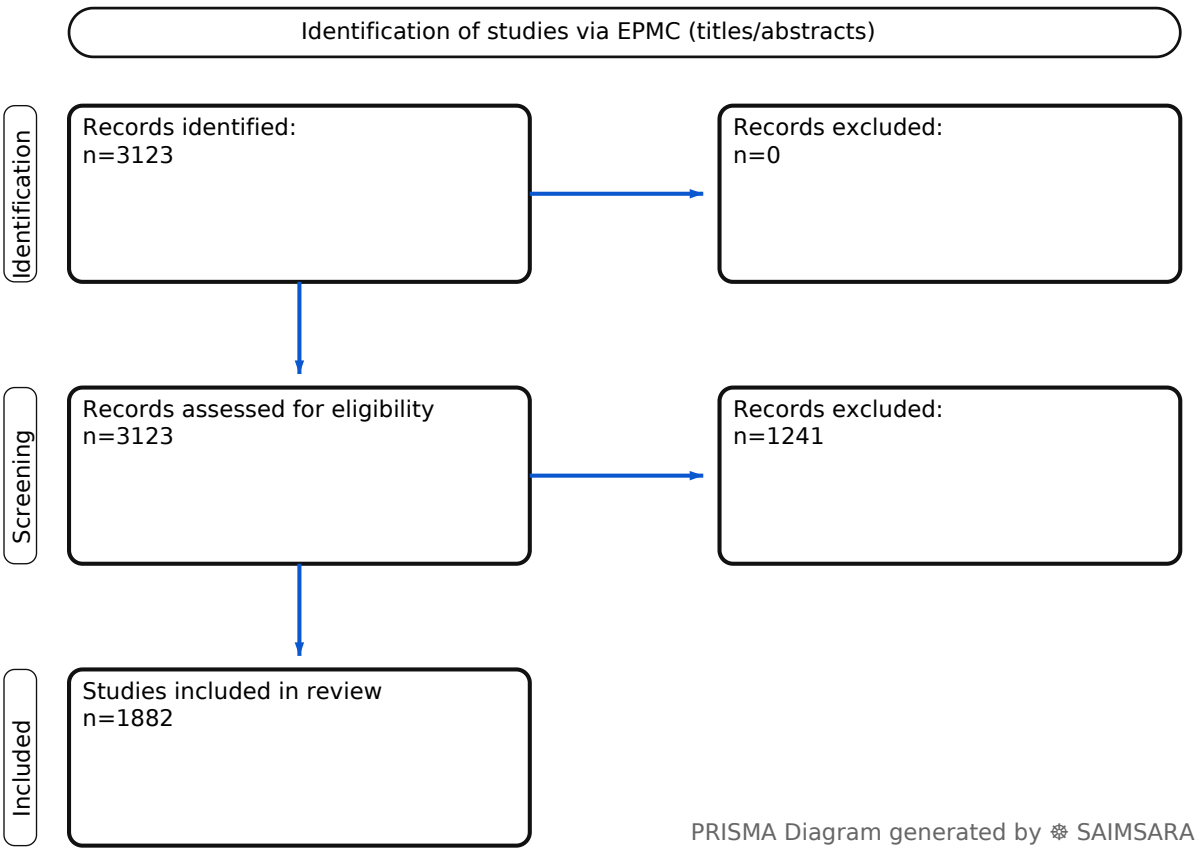
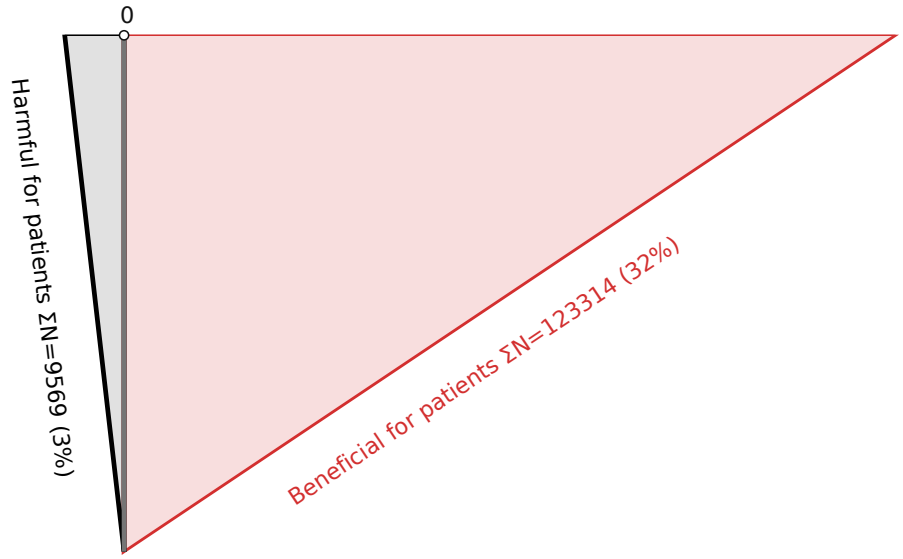
- Source: Europe PMC
- Scope: Titles/Abstracts (tiab)
- Keyword Gate: Fuzzy (≥60% of required terms, minimum 2 terms matched in title/abstract)
- Total Abstracts/Papers: 3123
- Downloaded Abstracts/Papers: 3123
- Included original Abstracts/Papers: 1882
- Total study participants (naïve ΣN): 380011



PRISMA Diagram generated by ☸ SAIMSARA

△OSMA Triangle
Effect-of Predictor → Outcome
personalized healthcare research → Outcome



Neutral ΣN=247128 (65%)

△OSMA Triangle generated by ☸SAIMSARA

Outcome-Sentiment Meta-Analysis (OSMA): *(LLM-only)*

Frame: Effect-of Predictor → Outcome • *Source*: Europe PMC

Outcome: Outcome Typical timepoints: 3-day, peri/post-op. Reported metrics: %, CI, p.

Common endpoints: Common endpoints: complications, qol, functional.

Predictor: personalized healthcare research — exposure/predictor. Routes seen: oral, topical, intravenous, iv. Typical comparator: control, standard messages, generic reminders, general bereavement support.…

- **1) Beneficial for patients** — Outcome with personalized healthcare research — [2], [6], [14], [23], [51], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83], [84], [85], [86], [87], [88], [89], [90], [91], [92], [93], [94], [95], [96], [97], [98], [99], [100], [101], [102], [103], [104], [105], [106], [107], [108], [109], [110], [112], [113], [114], [115], [116], [117], [118], [119], [120], [121], [122], [123], [124], [125], [126], [127], [128], [129], [130], [131], [132], [133], [134], [135], [136], [137], [138], [139], [140], [141], [142], [143], [144], [145], [146], [147], [148], [149], [150], [154], [155], [157], [158], [159], [160], [161], [162], [163], [165], [167], [170], [171], [172], [174], [175], [176], [177], [179], [180], [181], [182], [184], [189], [190], [193], [195], [196], [200], [201], [202], [203], [206], [207], [208], [212], [213], [217], [220], [221], [222], [223], [225], [228], [229], [231], [232], [233], [234], [235], [236], [237], [238], [239], [240], [241], [242], [243], [244], [246], [247], [248], [249], [250], [255], [260], [265], [268], [272], [273], [280], [284], [287], [296], [297], [299], [351], [352], [353], [354], [355], [356], [357], [358], [359], [360], [361], [362], [363], [364], [365], [366], [367], [368], [369], [370], [371], [372], [373], [374], [375], [376], [377], [378], [379], [380], [381], [382], [383], [384], [385], [386], [387], [388], [389], [390], [391], [392], [393], [394], [395], [396], [397], [398], [399], [400], [401], [402], [403], [404], [405], [406], [407], [408], [409], [410], [411], [412], [413], [414], [415], [416], [417], [418], [419], [420], [421], [422], [423], [424], [425], [426], [427], [428], [429], [430], [431], [432], [433], [434], [435], [436], [437], [438], [439], [440], [441], [442], [443], [444], [445], [446], [447], [448], [449], [450], [451], [452], [453], [454], [455], [456], [457], [458], [459], [460], [461], [462], [463], [464], [465], [466], [467], [469], [470], [471], [472], [473], [474], [475], [476], [477], [478], [479], [480], [481], [482], [483], [484], [485], [486], [487], [488], [489], [490], [491], [492], [493], [494], [495], [497], [498], [499], [500], [551], [552], [556], [557], [558], [560], [562], [563], [564], [565], [566], [568], [569], [570], [571], [572], [576], [577], [578], [579], [580], [581], [582], [584], [586], [588], [589], [590], [592], [593], [594], [595], [596], [597], [600], [613], [651], [655], [657], [658], [670], [673], [674], [676], [679], [684], [686], [688],

[689], [692], [694], [701], [702], [704], [705], [706], [707], [710], [712], [713], [714], [715], [717], [725], [728], [729], [735], [738], [740], [742], [743], [744], [745], [747], [748], [751], [752], [753], [754], [755], [756], [757], [758], [759], [760], [761], [762], [763], [764], [765], [766], [767], [768], [769], [770], [771], [772], [773], [774], [775], [776], [777], [778], [779], [780], [781], [782], [783], [784], [785], [786], [787], [788], [789], [790], [791], [792], [793], [794], [795], [796], [797], [798], [799], [800], [801], [802], [804], [805], [806], [807], [808], [809], [810], [812], [813], [814], [815], [816], [817], [818], [819], [820], [822], [823], [824], [825], [826], [827], [828], [829], [830], [834], [835], [836], [837], [838], [839], [842], [843], [844], [845], [846], [847], [848], [850], [957], [967], [973], [979], [1002], [1003], [1004], [1005], [1008], [1010], [1011], [1016], [1018], [1020], [1021], [1023], [1024], [1026], [1033], [1034], [1036], [1038], [1041], [1044], [1048], [1054], [1059], [1063], [1064], [1081], [1082], [1083], [1085], [1088], [1092], [1096], [1101], [1102], [1103], [1104], [1105], [1106], [1107], [1108], [1109], [1110], [1111], [1112], [1113], [1114], [1115], [1116], [1117], [1118], [1119], [1120], [1121], [1122], [1124], [1125], [1126], [1127], [1128], [1129], [1130], [1131], [1132], [1133], [1134], [1135], [1136], [1137], [1138], [1139], [1140], [1142], [1143], [1144], [1145], [1146], [1147], [1148], [1149], [1150], [1151], [1152], [1153], [1154], [1155], [1156], [1157], [1158], [1159], [1160], [1161], [1163], [1164], [1165], [1166], [1167], [1168], [1169], [1170], [1171], [1172], [1174], [1175], [1176], [1177], [1178], [1179], [1180], [1181], [1182], [1183], [1184], [1185], [1186], [1187], [1188], [1189], [1190], [1192], [1193], [1194], [1195], [1196], [1197], [1198], [1200], [1208], [1221], [1247], [1248], [1302], [1303], [1305], [1306], [1307], [1308], [1309], [1311], [1312], [1313], [1314], [1315], [1316], [1317], [1318], [1320], [1321], [1322], [1323], [1324], [1326], [1328], [1329], [1330], [1331], [1332], [1333], [1334], [1335], [1336], [1337], [1338], [1339], [1340], [1341], [1342], [1343], [1344], [1345], [1346], [1347], [1348], [1349], [1350], [1353], [1357], [1372], [1377], [1378], [1384], [1385], [1401], [1402], [1403], [1404], [1405], [1406], [1407], [1410], [1411], [1413], [1414], [1415], [1416], [1417], [1418], [1419], [1420], [1421], [1422], [1423], [1424], [1426], [1427], [1428], [1429], [1430], [1431], [1433], [1434], [1435], [1436], [1437], [1438], [1439], [1440], [1441], [1442], [1443], [1444], [1445], [1446], [1447], [1448], [1449], [1450], [1487], [1489], [1493], [1504], [1505], [1513], [1515], [1520], [1522], [1554], [1567], [1571], [1585], [1605], [1620], [1637], [1655], [1659], [1693], [1702], [1734], [1773], [1776], [1780], [1799], [1801], [1803], [1807], [1811], [1812], [1813], [1820], [1821], [1823], [1845], [1850] — ΣN=123314

- **2) Harmful for patients** — Outcome with personalized healthcare research — [192], [518], [631], [726], [821], [853], [886], [896], [1007], [1025], [1123], [1191], [1199], [1319], [1327], [1399], [1408], [1425], [1452], [1510], [1614], [1683], [1881] — ΣN=9569

- **3) No clear effect** — Outcome with personalized healthcare research — [1], [3], [4], [5], [7], [8], [9], [10], [11], [12], [13], [15], [16], [17], [18], [19], [20], [21], [22], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [111], [151], [152], [153], [156], [164], [166], [168], [169], [173], [178], [183], [185], [186], [187], [188], [191], [194], [197], [198], [199], [204], [205], [209], [210], [211], [214], [215], [216], [218], [219], [224], [226], [227], [230], [245], [251], [252], [253], [254], [256], [257], [258], [259], [261], [262], [263], [264], [266], [267], [269], [270], [271], [274], [275], [276], [277], [278], [279], [281], [282], [283], [285], [286], [288], [289], [290], [291], [292], [293], [294], [295], [298], [300], [301], [302], [303], [304], [305], [306], [307], [308], [309], [310], [311], [312], [313], [314], [315], [316], [317], [318], [319], [320], [321], [322], [323], [324], [325], [326], [327], [328], [329], [330], [331], [332], [333], [334], [335], [336], [337], [338], [339], [340], [341], [342], [343], [344], [345], [346], [347], [348], [349], [350], [468], [496], [501], [502], [503], [504], [505], [506], [507], [508], [509], [510], [511], [512], [513], [514], [515], [516], [517], [519], [520], [521], [522], [523], [524], [525], [526], [527], [528], [529], [530], [531], [532], [533], [534], [535], [536], [537], [538], [539], [540], [541], [542], [543], [544], [545], [546], [547], [548], [549], [550], [553], [554], [555], [559], [561], [567], [573], [574], [575], [583], [585], [587], [591], [598], [599], [601], [602], [603], [604], [605], [606], [607], [608], [609], [610], [611], [612], [614], [615], [616], [617], [618], [619], [620], [621], [622], [623], [624], [625], [626], [627], [628], [629], [630], [632], [633], [634], [635], [636], [637], [638], [639], [640], [641], [642], [643], [644], [645], [646], [647], [648], [649], [650], [652], [653], [654], [656], [659], [660], [661], [662], [663], [664], [665], [666], [667], [668], [669], [671], [672], [675], [677], [678], [680], [681], [682], [683], [685], [687], [690], [691], [693], [695], [696], [697], [698], [699], [700], [703], [708], [709], [711], [716], [718], [719], [720], [721], [722], [723], [724], [727], [730], [731], [732], [733], [734], [736], [737], [739], [741], [746], [749], [750], [803], [811], [831], [832], [833], [840], [841], [849], [851], [852], [854], [855], [856], [857], [858], [859], [860], [861], [862], [863], [864], [865], [866], [867], [868], [869], [870], [871], [872], [873], [874], [875], [876], [877], [878], [879], [880], [881], [882], [883], [884], [885], [887], [888], [889], [890], [891], [892], [893], [894], [895], [897], [898], [899], [900], [901], [902], [903], [904], [905], [906], [907], [908], [909], [910], [911], [912], [913], [914], [915], [916], [917], [918], [919], [920], [921], [922], [923], [924], [925], [926], [927], [928], [929], [930], [931], [932], [933], [934], [935], [936], [937], [938], [939], [940], [941], [942], [943], [944], [945], [946], [947], [948], [949], [950], [951], [952], [953], [954], [955], [956], [958], [959], [960], [961], [962], [963], [964], [965], [966], [968], [969], [970], [971], [972], [974], [975], [976], [977], [978], [980], [981], [982], [983], [984], [985], [986], [987], [988], [989], [990], [991], [992], [993], [994], [995], [996], [997], [998],

[999], [1000], [1001], [1006], [1009], [1012], [1013], [1014], [1015], [1017], [1019], [1022], [1027], [1028], [1029], [1030], [1031], [1032], [1035], [1037], [1039], [1040], [1042], [1043], [1045], [1046], [1047], [1049], [1050], [1051], [1052], [1053], [1055], [1056], [1057], [1058], [1060], [1061], [1062], [1065], [1066], [1067], [1068], [1069], [1070], [1071], [1072], [1073], [1074], [1075], [1076], [1077], [1078], [1079], [1080], [1084], [1086], [1087], [1089], [1090], [1091], [1093], [1094], [1095], [1097], [1098], [1099], [1100], [1141], [1162], [1173], [1201], [1202], [1203], [1204], [1205], [1206], [1207], [1209], [1210], [1211], [1212], [1213], [1214], [1215], [1216], [1217], [1218], [1219], [1220], [1222], [1223], [1224], [1225], [1226], [1227], [1228], [1229], [1230], [1231], [1232], [1233], [1234], [1235], [1236], [1237], [1238], [1239], [1240], [1241], [1242], [1243], [1244], [1245], [1246], [1249], [1250], [1251], [1252], [1253], [1254], [1255], [1256], [1257], [1258], [1259], [1260], [1261], [1262], [1263], [1264], [1265], [1266], [1267], [1268], [1269], [1270], [1271], [1272], [1273], [1274], [1275], [1276], [1277], [1278], [1279], [1280], [1281], [1282], [1283], [1284], [1285], [1286], [1287], [1288], [1289], [1290], [1291], [1292], [1293], [1294], [1295], [1296], [1297], [1298], [1299], [1300], [1301], [1304], [1310], [1325], [1351], [1352], [1354], [1355], [1356], [1358], [1359], [1360], [1361], [1362], [1363], [1364], [1365], [1366], [1367], [1368], [1369], [1370], [1371], [1373], [1374], [1375], [1376], [1379], [1380], [1381], [1382], [1383], [1386], [1387], [1388], [1389], [1390], [1391], [1392], [1393], [1394], [1395], [1396], [1397], [1398], [1400], [1409], [1412], [1432], [1451], [1453], [1454], [1455], [1456], [1457], [1458], [1459], [1460], [1461], [1462], [1463], [1464], [1465], [1466], [1467], [1468], [1469], [1470], [1471], [1472], [1473], [1474], [1475], [1476], [1477], [1478], [1479], [1480], [1481], [1482], [1483], [1484], [1485], [1486], [1488], [1490], [1491], [1492], [1494], [1495], [1496], [1497], [1498], [1499], [1500], [1501], [1502], [1503], [1506], [1507], [1508], [1509], [1511], [1512], [1514], [1516], [1517], [1518], [1519], [1521], [1523], [1524], [1525], [1526], [1527], [1528], [1529], [1530], [1531], [1532], [1533], [1534], [1535], [1536], [1537], [1538], [1539], [1540], [1541], [1542], [1543], [1544], [1545], [1546], [1547], [1548], [1549], [1550], [1551], [1552], [1553], [1555], [1556], [1557], [1558], [1559], [1560], [1561], [1562], [1563], [1564], [1565], [1566], [1568], [1569], [1570], [1572], [1573], [1574], [1575], [1576], [1577], [1578], [1579], [1580], [1581], [1582], [1583], [1584], [1586], [1587], [1588], [1589], [1590], [1591], [1592], [1593], [1594], [1595], [1596], [1597], [1598], [1599], [1600], [1601], [1602], [1603], [1604], [1606], [1607], [1608], [1609], [1610], [1611], [1612], [1613], [1615], [1616], [1617], [1618], [1619], [1621], [1622], [1623], [1624], [1625], [1626], [1627], [1628], [1629], [1630], [1631], [1632], [1633], [1634], [1635], [1636], [1638], [1639], [1640], [1641], [1642], [1643], [1644], [1645], [1646], [1647], [1648], [1649], [1650], [1651], [1652], [1653], [1654], [1656], [1657], [1658], [1660], [1661], [1662], [1663], [1664], [1665], [1666], [1667], [1668], [1669], [1670], [1671], [1672], [1673],

[1674], [1675], [1676], [1677], [1678], [1679], [1680], [1681], [1682], [1684], [1685], [1686], [1687], [1688], [1689], [1690], [1691], [1692], [1694], [1695], [1696], [1697], [1698], [1699], [1700], [1701], [1703], [1704], [1705], [1706], [1707], [1708], [1709], [1710], [1711], [1712], [1713], [1714], [1715], [1716], [1717], [1718], [1719], [1720], [1721], [1722], [1723], [1724], [1725], [1726], [1727], [1728], [1729], [1730], [1731], [1732], [1733], [1735], [1736], [1737], [1738], [1739], [1740], [1741], [1742], [1743], [1744], [1745], [1746], [1747], [1748], [1749], [1750], [1751], [1752], [1753], [1754], [1755], [1756], [1757], [1758], [1759], [1760], [1761], [1762], [1763], [1764], [1765], [1766], [1767], [1768], [1769], [1770], [1771], [1772], [1774], [1775], [1777], [1778], [1779], [1781], [1782], [1783], [1784], [1785], [1786], [1787], [1788], [1789], [1790], [1791], [1792], [1793], [1794], [1795], [1796], [1797], [1798], [1800], [1802], [1804], [1805], [1806], [1808], [1809], [1810], [1814], [1815], [1816], [1817], [1818], [1819], [1822], [1824], [1825], [1826], [1827], [1828], [1829], [1830], [1831], [1832], [1833], [1834], [1835], [1836], [1837], [1838], [1839], [1840], [1841], [1842], [1843], [1844], [1846], [1847], [1848], [1849], [1851], [1852], [1853], [1854], [1855], [1856], [1857], [1858], [1859], [1860], [1861], [1862], [1863], [1864], [1865], [1866], [1867], [1868], [1869], [1870], [1871], [1872], [1873], [1874], [1875], [1876], [1877], [1878], [1879], [1880], [1882] — ΣN=247128

1) Introduction

Personalized healthcare represents a paradigm shift from a one-size-fits-all approach to patient management, emphasizing tailored interventions based on individual characteristics such as genetic makeup, lifestyle, and environmental factors. This evolving field aims to optimize diagnostic precision, therapeutic efficacy, and preventive strategies, ultimately enhancing patient outcomes and healthcare quality. The rapid integration of advanced technologies, particularly artificial intelligence (AI) and digital health tools, is accelerating this transformation, promising more proactive, efficient, and patient-centered care models.

2) Aim

This paper aims to systematically review the current landscape of personalized healthcare research, synthesizing key technological advancements, application areas, and associated challenges as identified in recent literature.

3) Methods

Systematic review with multilayer AI research agent: keyword normalization, retrieval & structuring,

and paper synthesis (see SAIMSARA About section for details).

- **Bias:** The majority of included studies are mixed-design or do not specify a study design (N/A), indicating a prevalence of conceptual, developmental, and review-based research rather than large-scale, robust experimental trials. While some cohort studies and randomized controlled trials (RCTs) are present, their limited number and diverse methodologies introduce qualitative bias, making direct comparisons and generalized conclusions challenging.

4) Results

4.1 Study characteristics:

The review encompasses a broad range of studies, predominantly featuring mixed-methods designs or unspecified methodologies (N/A), with a smaller number of cohort studies and randomized controlled trials. Research populations span diverse areas, including individuals with chronic conditions (e.g., hypertension, diabetes, COPD, cardiovascular diseases, cancer), elderly individuals, pediatric populations, and those with specific neurological or mental health disorders. Most studies lack specified sample sizes, follow-up periods, or detailed statistical reporting, focusing instead on conceptual frameworks, technological development, and preliminary efficacy. The majority of the research was published in 2025, indicating a highly current and rapidly evolving field.

4.2 Main numerical result aligned to the query:

Across various studies evaluating AI-driven diagnostic agents and systems for personalized healthcare, the median reported accuracy for diagnostic tasks was 95.4% [95, 172, 332, 334, 575, 609, 633, 651, 693, 895]. This ranged from 85% for pooled diagnostic accuracy in psychiatry [633] to 98.18% for lung cancer classification using CT scans [334]. Other metrics, such as F1 scores, sensitivity, and specificity, also demonstrated high performance, supporting the potential of AI in enhancing diagnostic precision for personalized care.

4.3 Topic synthesis:

- **AI and Machine Learning for Diagnostics and Treatment:** AI and machine learning (ML) significantly enhance diagnostic precision, care quality, and decision-making across various conditions, including chronic diseases, cancer, and neurological disorders [9, 11, 19, 30, 33, 47, 48, 52, 70, 76, 77, 79, 88, 95, 110, 115, 117, 119, 125, 131, 132, 146, 157, 159, 161, 162, 175, 190, 203, 206, 231, 233, 238, 254, 255, 261, 293, 299, 300, 305, 309, 332, 334, 343, 344, 345, 352, 353, 360, 361, 368, 369, 373, 374, 384, 386, 394, 405, 411, 419, 422, 430, 440, 447, 450, 452, 453, 454, 458, 470, 475, 485, 487, 489, 494, 495, 498, 506, 511, 517, 520, 521, 530, 531, 536, 544, 546, 562, 567, 569, 575, 581, 584, 586, 589, 590,

592, 593, 597, 600, 609, 611, 612, 617, 622, 623, 626, 633, 636, 637, 643, 649, 653, 654, 658, 693, 705, 744, 895, 1011, 1031, 1052, 1067, 1104, 1125, 1169].

- **Wearable Technologies and Remote Monitoring:** Flexible wearable sensors and Edge AI systems enable real-time, non-invasive monitoring of vital signs and biochemical markers, facilitating personalized management for chronic diseases and early detection of health issues [1, 10, 56, 58, 67, 80, 112, 121, 164, 176, 187, 189, 191, 208, 216, 217, 223, 232, 251, 256, 271, 274, 285, 304, 380, 383, 460, 461, 500, 513, 556, 557, 596, 597, 601, 630, 644, 1012, 1201, 1218, 1769].
- **Genomics and Multi-omics for Precision Medicine:** Genomic information, multi-omics data, and bioinformatics tools are revolutionizing personalized medicine by enabling genome-based diagnostics, polygenic risk scores (PRS), and tailored therapeutic strategies for genetic disorders, cancer, and chronic conditions [12, 18, 24, 29, 31, 35, 65, 83, 87, 96, 97, 103, 108, 116, 130, 131, 133, 139, 144, 155, 169, 207, 218, 219, 221, 226, 230, 237, 239, 246, 257, 261, 262, 266, 281, 282, 286, 293, 300, 309, 310, 311, 349, 350, 355, 357, 363, 364, 396, 407, 417, 426, 439, 445, 468, 476, 486, 487, 498, 499, 520, 524, 525, 534, 538, 560, 565, 576, 586, 587, 595, 614, 618, 621, 631, 643, 646, 661, 705, 725, 734, 822, 883, 919, 1032, 1067, 1074, 1101, 1104, 1134, 1377, 1391, 1735, 1783, 1829].
- **Digital Health Tools and Platforms:** Clinical Decision Support Systems (CDSS), Electronic Health Records (EHRs), telemedicine, and mobile health (mHealth) applications integrate patient-specific data with guidelines to generate personalized recommendations, improve patient safety, and enhance engagement, with patient engagement improving by 30% and satisfaction by 25% in one study [4, 5, 6, 25, 27, 44, 46, 48, 79, 91, 92, 95, 100, 107, 112, 123, 125, 141, 150, 151, 153, 163, 1693, 1707, 1760, 202, 206, 209, 214, 227, 229, 272, 274, 287, 290, 292, 301, 305, 313, 322, 327, 328, 329, 331, 337, 338, 343, 345, 350, 354, 356, 362, 367, 369, 371, 372, 377, 382, 383, 387, 392, 397, 403, 416, 418, 419, 421, 422, 424, 429, 437, 438, 442, 444, 463, 470, 481, 483, 484, 494, 501, 506, 508, 512, 515, 518, 521, 523, 526, 531, 533, 543, 547, 549, 550, 551, 555, 558, 567, 569, 578, 579, 583, 590, 598, 603, 606, 607, 618, 620, 625, 627, 628, 630, 635, 642, 647, 650, 669, 670, 695, 780, 793, 811, 821, 841, 1052, 1307, 1363, 1445, 1447, 1503, 1631, 1638, 1663, 1707, 1760, 1784, 1799, 1803, 1829, 1881].
- **Advanced Manufacturing and Bioengineering:** Technologies like 3D bioprinting, organoids, and microphysiological systems are enabling the fabrication of patient-specific models and tissues, revolutionizing regenerative medicine and personalized drug testing [32, 69, 78, 152, 242, 247, 264, 291, 432, 455, 1309, 1597, 1691].
- **Ethical, Social, and Implementation Challenges:** Despite technological advancements, significant barriers remain, including concerns over data privacy, security, and ethical use of AI [27, 86, 115, 125, 141, 259, 290, 331, 373, 382, 386, 392, 403, 410, 416, 422, 442, 521, 550, 558, 567, 581, 612, 622, 793], the digital divide [6], and the need for equitable access

and culturally sensitive approaches [124, 139, 160, 166, 218, 237, 310, 313, 355, 396, 426, 439, 486, 496, 525, 539, 618, 648, 695, 725, 883, 106]. Patient willingness to share personal health data for research was high at 94% in one study [163].

- **Preventive and Predictive Medicine:** Personalized healthcare is shifting towards predictive, preventive, and personalized medicine (PPPM/3PM) [16, 48, 229, 309, 565], leveraging AI and data analytics for early disease detection, risk stratification, and proactive interventions across various conditions, including chronic illnesses, cancer, and cognitive decline [5, 11, 19, 80, 92, 103, 112, 1447, 1484, 1570, 1613, 1783, 1829, 207, 214, 215, 231, 238, 255, 256, 299, 300, 304, 313, 335, 340, 341, 348, 356, 367, 379, 383, 385, 412, 414, 417, 423, 437, 450, 453, 468, 481, 484, 489, 498, 523, 541, 543, 546, 562, 576, 583, 587, 609, 611, 621, 631, 636, 637, 638, 646, 649, 651, 653, 654, 658, 670, 725, 734, 792, 821, 895, 1011, 1031, 1032, 1054, 1125, 1454].

5) Discussion

5.1 Principal finding:

The central finding indicates that AI-driven diagnostic agents and systems demonstrate a median diagnostic accuracy of 95.4% (range: 85-98.18%) across various healthcare applications, suggesting significant potential for enhancing precision in personalized care [95, 172, 332, 334, 575, 609, 633, 651, 693, 895].

5.2 Clinical implications:

- **Improved Diagnostic Accuracy:** AI-powered tools can significantly enhance the accuracy of disease detection and risk assessment, leading to earlier and more precise diagnoses across diverse medical fields [9, 52, 77, 110, 157, 238, 334, 458, 498, 609].
- **Optimized Treatment Strategies:** Personalized treatment plans, informed by genomic data, real-time monitoring, and AI-driven insights, can reduce adverse reactions and improve patient outcomes in conditions ranging from cancer to chronic diseases and mental health disorders [12, 18, 115, 146, 261, 309, 335, 374, 457, 482, 572, 573, 589, 636].
- **Enhanced Patient Engagement:** Digital tools and personalized communication strategies can empower patients, increasing their engagement (30% improvement) and adherence (40% improvement) to treatment plans, particularly in managing chronic conditions and promoting health literacy [6, 91, 202, 232, 356, 371, 418, 578, 607, 647].
- **Streamlined Clinical Workflows:** AI-enabled systems can improve hospital operations, clinical decision-making, and administrative efficiency, allowing healthcare professionals to focus more on patient-centered care and extend specialist-level support to underserved areas [9, 70, 88, 117, 190, 206, 254, 343, 386, 485, 495, 744, 895].

- **Proactive and Preventive Care:** Wearable technologies and predictive analytics enable continuous health monitoring and early detection of potential health issues, facilitating timely interventions and preventive strategies for various populations, including the elderly and those at risk for chronic diseases [1, 10, 80, 112, 229, 383, 417, 500, 565, 601].

5.3 Research implications / key gaps:

- **Standardized Data Interoperability:** Future research should focus on developing and implementing common data models and interoperability standards (e.g., OMOP-on-FHIR) to facilitate seamless, secure data exchange between clinical systems and research databases, crucial for advancing personalized medicine [44, 123, 227, 345, 625, 1074, 1391, 1760].
- **Ethical AI Frameworks:** Research is needed to establish robust ethical frameworks and application guidelines for AI in healthcare, addressing critical concerns such as data privacy, security, algorithmic bias, and model interpretability to ensure responsible deployment and patient trust [27, 86, 115, 125, 141, 1476, 290, 331, 373, 382, 386, 392, 403, 410, 416, 422, 521, 550, 558, 567, 581, 612, 622, 793].
- **Longitudinal Efficacy of Interventions:** There is a critical need for more large-scale, prospective randomized controlled trials to rigorously evaluate the long-term effectiveness, cost-efficiency, and generalizability of personalized interventions across diverse patient populations and health conditions [91, 118, 191, 268, 292, 371, 437, 533, 598, 607, 647, 1307, 1377].
- **Ancestry-Specific Genomic Research:** Research efforts must expand to include diverse and underrepresented populations (e.g., African, South Asian) in genomic and multi-omics studies to address health disparities, ensure equitable access, and develop truly personalized medicine approaches that account for genetic diversity [12, 106, 139, 237, 355, 396, 426, 439, 468, 486, 496, 525, 618, 648, 661, 725, 883].
- **Integration of Multimodal AI Systems:** Future research should focus on developing advanced analytical ecosystems and foundation models that can seamlessly integrate and synthesize real-time, multimodal data from wearables, EHRs, omics, and other sources to provide comprehensive, predictive, and personalized insights for clinical decision-making [15, 19, 29, 31, 48, 56, 119, 125, 155, 159, 169, 231, 238, 249, 281, 309, 344, 348, 353, 363, 405, 408, 414, 476, 487, 524, 565, 586, 630, 670, 1031, 1069, 1074, 1391, 1447, 1769, 1829].

5.4 Limitations:

- **Lack of Standardized Study Designs** — Many studies are conceptual or developmental, limiting direct comparison and generalizability of findings.
- **Limited Sample Sizes** — A significant number of studies lack specified sample sizes or involve small cohorts, which restricts the statistical power and external validity of their results.
- **Heterogeneity of Metrics** — Diverse outcome measures and reporting metrics across studies make it challenging to synthesize quantitative results comprehensively.
- **Ethical and Privacy Concerns** — Recurring concerns about data privacy, security, and the ethical implications of AI deployment and data sharing remain largely unaddressed in practical implementation.
- **Implementation Barriers** — Challenges in translating research into routine clinical practice, including provider knowledge gaps, digital divide issues, and organizational resistance, hinder widespread adoption.

5.5 Future directions:

- **Develop Ethical AI Frameworks** — Establish robust guidelines for responsible AI deployment in healthcare.
- **Conduct Large-Scale RCTs** — Evaluate personalized interventions with rigorous, long-term study designs.
- **Enhance Data Interoperability** — Implement standardized data models for seamless data exchange.
- **Expand Genomic Diversity Research** — Focus on underrepresented populations in multi-omics studies.
- **Integrate Multimodal AI Systems** — Develop platforms for comprehensive data synthesis and real-time insights.

6) Conclusion

AI-driven diagnostic agents and systems demonstrate a median diagnostic accuracy of 95.4% (range: 85-98.18%) across various healthcare applications, suggesting significant potential for enhancing precision in personalized care [95, 172, 332, 334, 575, 609, 633, 651, 693, 895]. This broad potential extends across diverse conditions and populations, promising more tailored and effective healthcare solutions. However, the **Lack of Standardized Study Designs** in much of the current literature significantly limits the certainty and generalizability of these promising findings. Therefore, continued investment in developing robust ethical AI frameworks and conducting large-scale, rigorously designed clinical trials is essential to translate these technological advancements into equitable and

impactful personalized healthcare practices.

References

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Figure 1. Publication-year distribution of included originals

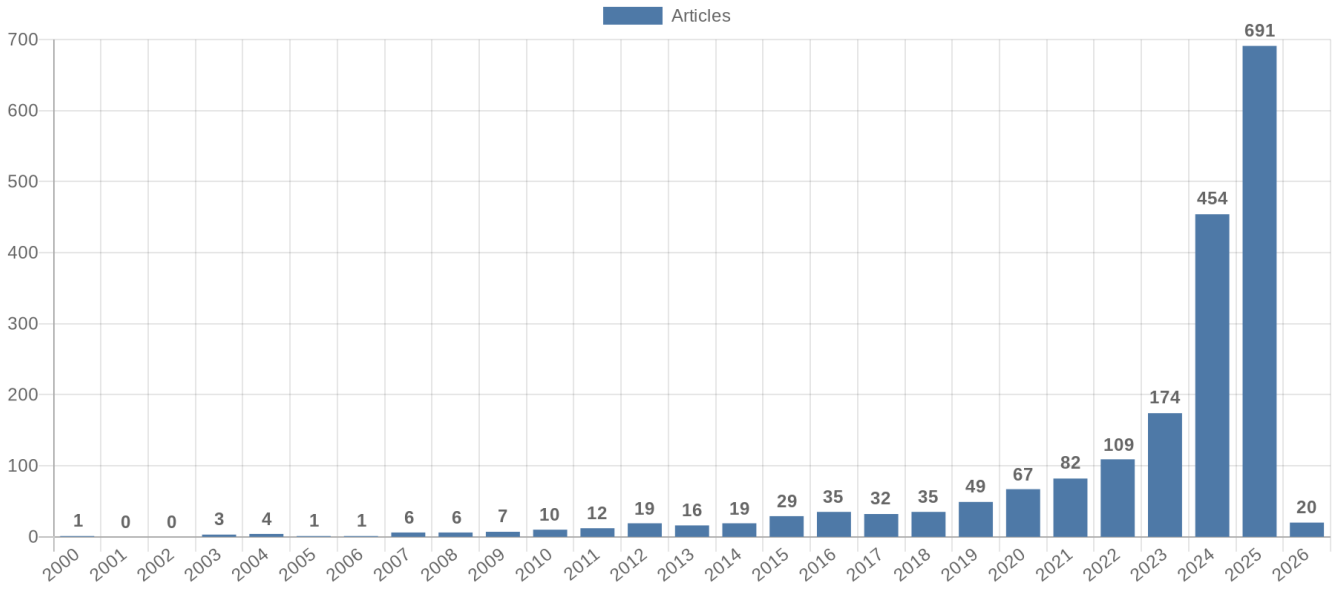

Figure 2. Study-design distribution of included originals

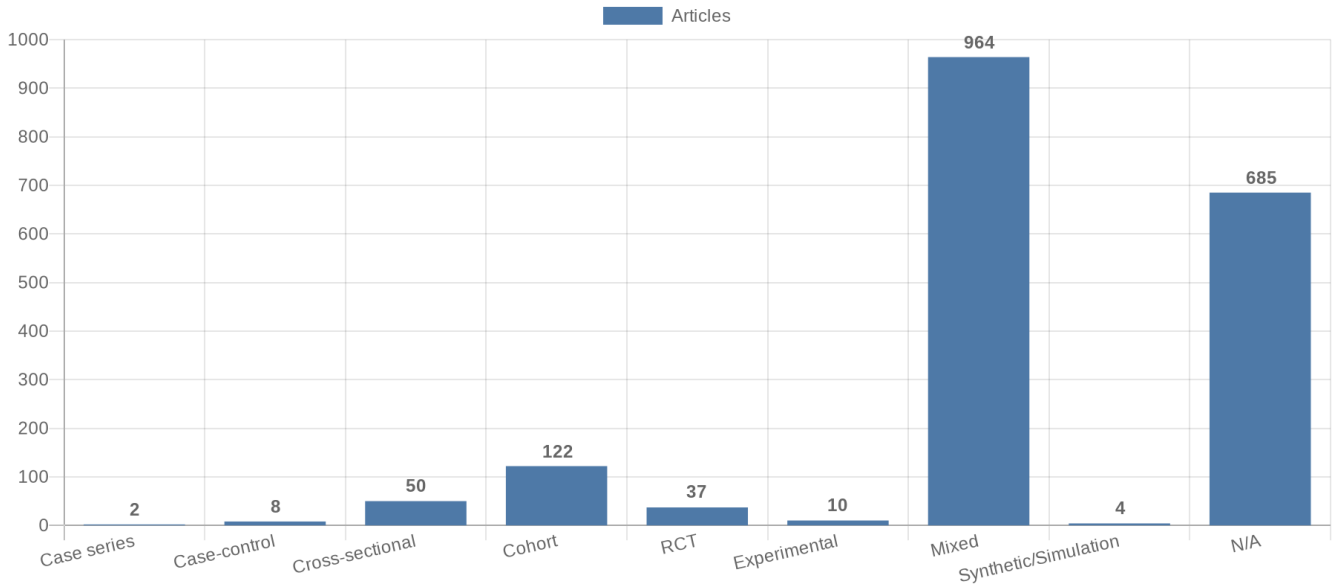

Figure 3. Study-type (directionality) distribution of included originals

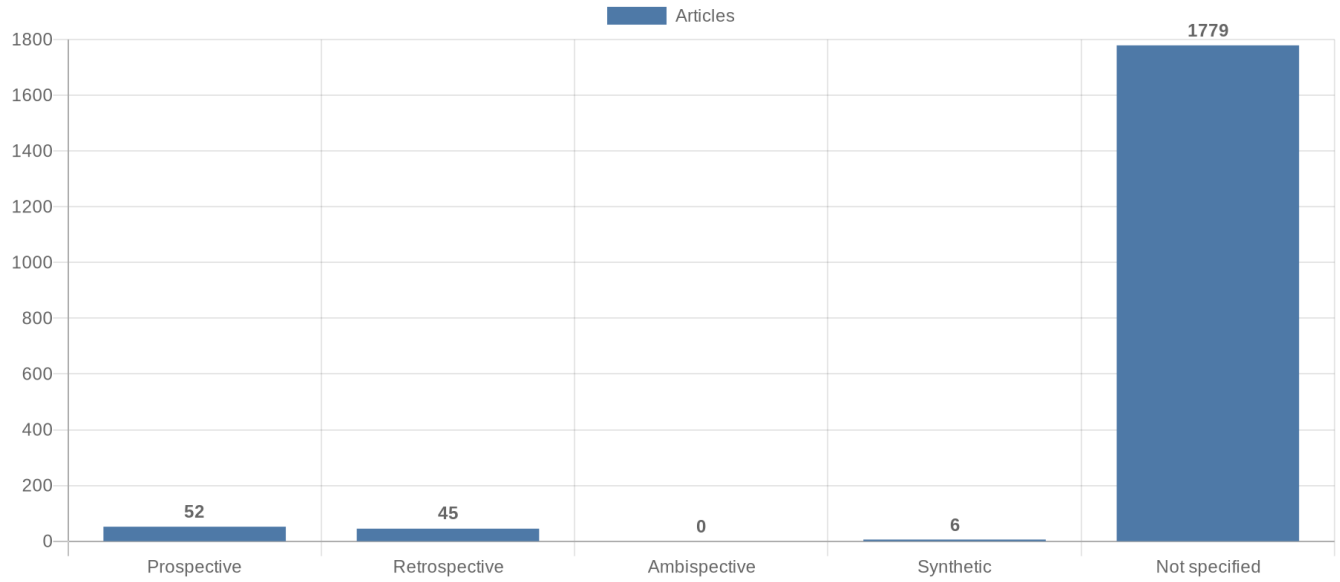

Figure 4. Main extracted research topics

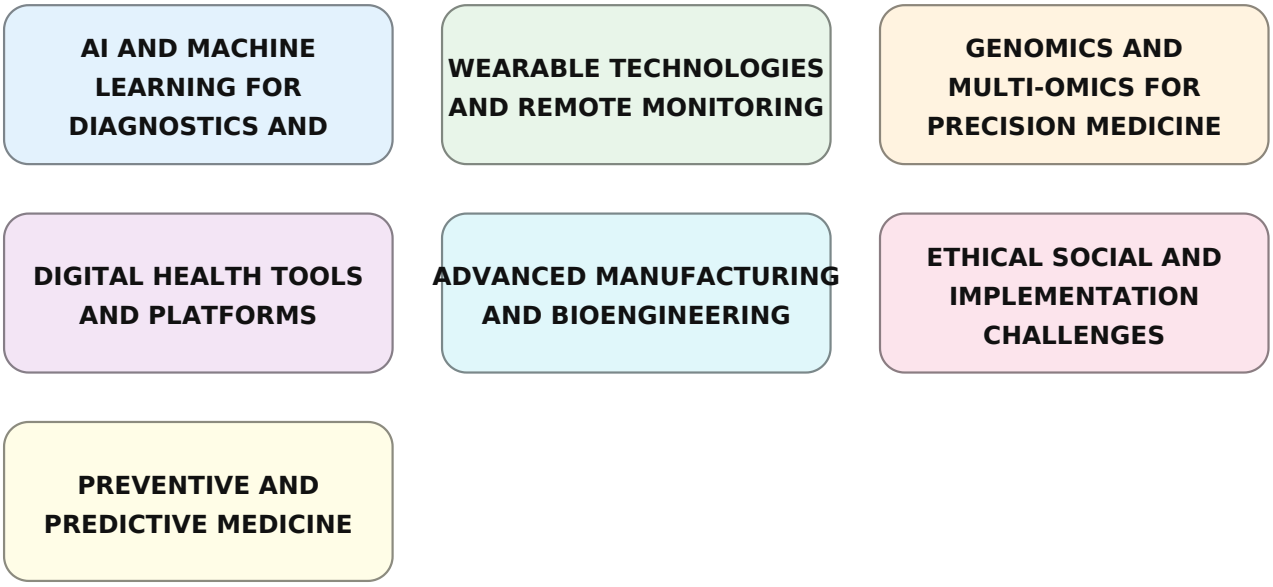

Figure 5. Limitations of current studies (topics)

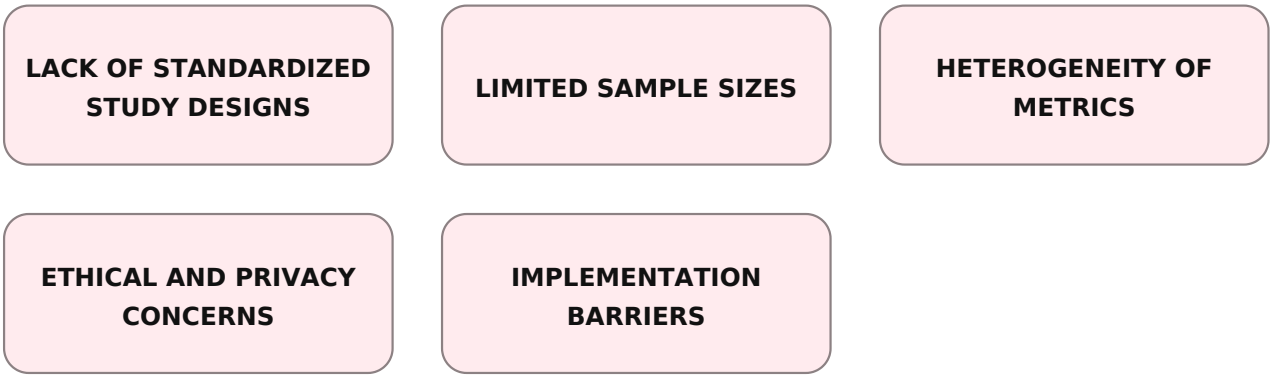

Figure 6. Future research directions (topics)

STANDARDIZED DATA INTEROPERABILITY

ETHICAL AI FRAMEWORKS

LONGITUDINAL EFFICACY OF INTERVENTIONS

ANCESTRY-SPECIFIC GENOMIC RESEARCH

INTEGRATION OF MULTIMODAL AI SYSTEMS

LACK OF STANDARDIZED STUDY DESIGNS