


# Definition of patient complexity in adults: A narrative review

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Stefanie Nicolaus<sup>1</sup>, Baptiste Crelier<sup>2</sup>, Jacques D Donzé<sup>3,4,5</sup> and Carole E Aubert<sup>2,6,7,8</sup> 

## Abstract

**Background:** Better identification of complex patients could help to improve their care. However, the definition of patient complexity itself is far from obvious. We conducted a narrative review to identify, describe, and synthesize the definitions of patient complexity used in the last 25 years.

**Methods:** We searched PubMed for articles published in English between January 1995 and September 2020, defining patient complexity. We extended the search to the references of the included articles. We assessed the domains presented in the definitions, and classified the definitions as based on (1) medical aspects (e.g., number of conditions) or (2) medical and/or non-medical aspects (e.g., socio-economic status). We assessed whether the definition was based on a tool (e.g., index) or conceptual model.

**Results:** Among 83 articles, there was marked heterogeneity in the patient complexity definitions. Domains contributing to complexity included health, demographics, behavior, socio-economic factors, healthcare system, medical decision-making, and environment. Patient complexity was defined according to medical aspects in 30 (36.1%) articles, and to medical and/or non-medical aspects in 53 (63.9%) articles. A tool was used in 36 (43.4%) articles, and a conceptual model in seven (8.4%) articles.

**Conclusion:** A consensus concerning the definition of patient complexity was lacking. Most definitions incorporated non-medical factors in the definition, underlining the importance of accounting not only for medical but also for non-medical aspects, as well as for their interrelationship.

## Keywords

complex, complexity, patient complexity, multimorbidity

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## Background

During recent years, improvements in therapeutic and preventive care have not only led to an increase in life expectancy but also in the prevalence of multimorbidity and patient complexity.<sup>1–3</sup> Multimorbidity affects two-thirds of the older (65 years or older) population, and is responsible for 65% of total healthcare costs.<sup>1,2,4</sup> Patient complexity is associated with higher healthcare resource consumption<sup>5–10</sup> and increased needs for social support.<sup>11–13</sup> Patient complexity is therefore associated with a significant burden for healthcare systems and society as a whole.<sup>1,6,14,15</sup> Furthermore, patients

<sup>1</sup>Department of General Internal Medicine, Biel Hospital, Biel, Switzerland

<sup>2</sup>Department of General Internal Medicine, Bern University Hospital, Inselspital, University of Bern, Inselspital, Bern, Switzerland

<sup>3</sup>Department of Medicine, Neuchâtel Hospital Network, Neuchâtel, Switzerland

<sup>4</sup>Division of General Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

<sup>5</sup>Division of Internal Medicine, Lausanne University Hospital, Lausanne, Switzerland

<sup>6</sup>Institute of Primary Health Care (BIHAM), University of Bern, Bern, Switzerland

<sup>7</sup>Center for Clinical Management Research, Veterans Affairs Ann Arbor Healthcare System, Ann Arbor, MI, USA

<sup>8</sup>Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI, USA

## Corresponding author:

Carole E Aubert, Department of General Internal Medicine, Inselspital, Bern University Hospital, Freiburgstrasse, Bern CH-3010, Switzerland.  
Email: [@aubert\\_carole](mailto:@aubert_carole); [caroleelodie.aubert@insel.ch](mailto:caroleelodie.aubert@insel.ch)



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with complex needs have a higher risk for adverse health outcomes, and experience poorer quality of care and lower satisfaction with care.<sup>16,17</sup>

Several methods have been used to assess patient complexity, but to date none has been broadly implemented in clinical practice.<sup>1,18–20</sup> Although most methods only described or counted the diseases or medications, many parameters other than medical aspects, such as health literacy, socio-economic, cultural, environmental, or behavioral factors, may contribute to patient complexity.<sup>1</sup> In addition, a patient even with a single condition can be considered complex; for example, if there is a language barrier or they are unable to pay for care. On the other hand, another patient with multiple but well-controlled chronic conditions and who has no other factor complicating care, may be relatively easy to manage. Finally, patient complexity is partly practitioner-dependent. Patient complexity is thus not trivial to define.

Furthermore, there is little guidance for disc, patients and informal caregivers to manage complex patients, although this could help to improve their care and outcomes.<sup>1,10,12,16,21</sup>

Before developing such recommendations; however, we must first be able to define and identify patient complexity in a standardized way. The aim of this study was thus to review the literature, in order to summarize, describe, and categorize key elements of definitions of patient complexity in adults.

## Methods

We conducted a narrative literature review of patient complexity.

### Search strategy

We searched PubMed to identify any type of article reporting a definition of patient complexity in adults. The search was limited to articles published in English between January 1995 and September 2020 ([Supplementary Material](#)). The earlier time limit was chosen to focus on most recent articles, because the recent evolution of treatment and diagnosis possibilities (e.g., imaging availability) may have significantly impacted patient complexity and its definition. One reviewer (BC) identified all articles mentioning the term “complexity” in the title and/or abstract. Among these, articles that were not about patient complexity (e.g., complex system and complex procedure), focused on a pediatric population, referred to complexity without providing any definition, or were not in English, were excluded. The references of the included articles were finally screened for potential additional relevant articles. Uncertainties about relevance of an article were discussed with a senior author (CEA or JDD).

### Data extraction

Two authors (BC and SN) extracted the data from the articles. All disagreements or uncertainties were discussed

with a senior author. Extracted information included the first author, publication year, type of article (e.g., editorial, prospective or retrospective cohort study, randomized controlled trial, survey), type and size of sample (number and type of subjects (e.g., patients, physicians) involved), setting, and definition of patient complexity.

### Data categorization and analysis

First, we identified and described the domains contributing to patient complexity, as they were stated in the articles. Second, we classified the definitions of patient complexity into two groups: (1) based on medical aspects (e.g., number of conditions and polypharmacy); (2) based on medical and non-medical aspects (e.g., socio-economic status, behavior, cultural or environmental aspects). Third, we classified the definitions as to whether they used a tool (e.g., Charlson Comorbidity Index (CCI), Integrated Medicine (INTERMED)) or a conceptual model to assess patient complexity.

## Results

### Article characteristics

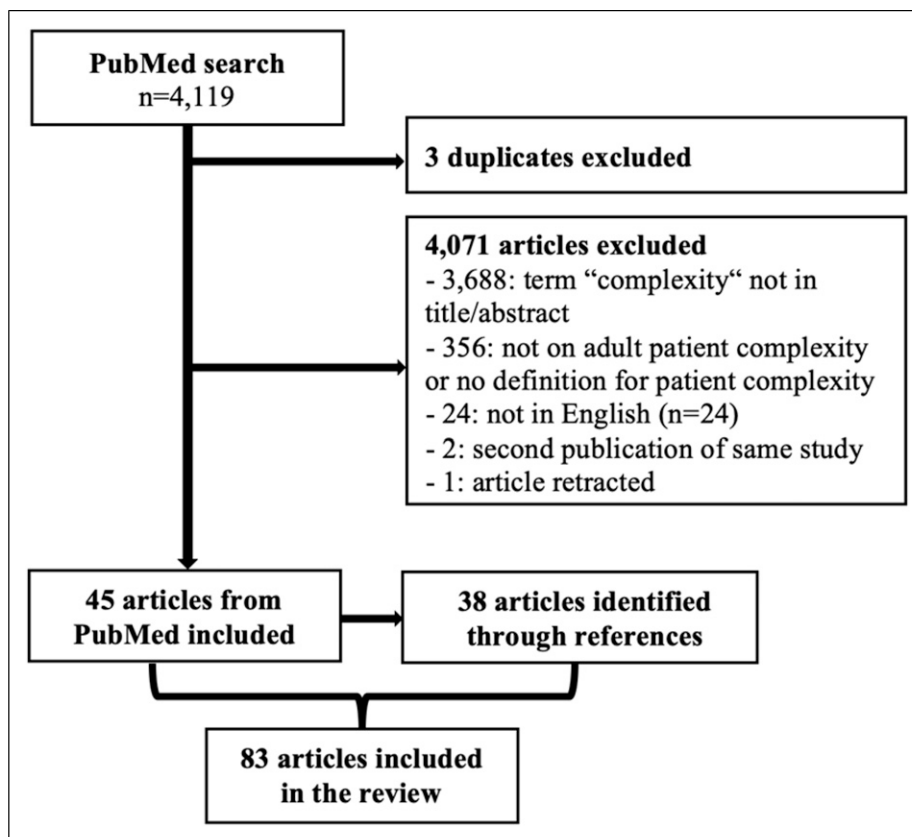
Among the 4119 articles identified in PubMed, 45 were included in the review ([Figure 1](#)). We identified 38 additional articles by searching the references, leading to a total of 83 articles. [Tables 1–5](#) report the first author, publication year, article type, type and size of sample, setting, and definition of patient complexity. Most articles were prospective or retrospective cohort studies ( $n = 24$ , 28.9%), literature reviews ( $n = 15$ , 18.1%), or cross-sectional studies ( $n = 14$ , 16.9%), and concerned the outpatient setting ( $n = 65$ , 78.3%). Defining patient complexity was the explicit aim of eight (9.96%) articles.<sup>1,16,22–27</sup>

### Domains contributing to patient complexity

We identified the following domains as contributing to patient complexity: demographics (e.g., age, sex, race, and culture), patient personal characteristics or behavior (e.g., communication, burden of disease, coping strategies, and resilience), socio-economic factors, medical, and mental health (e.g., severity of illness, psychiatric disorders, addiction, cognitive impairment), patient risk of mortality, and healthcare system (e.g., care coordination and healthcare utilization), medical decision-making, and environment (e.g., pollution and neighborhood).

### Categorization of the definitions

Thirty articles (36.1%) defined patient complexity based on medical aspects only ([Tables 1 and 5](#)), among which 15 used a specific tool (index, algorithm, code, score, or diagnostic



**Figure 1.** Flow-chart of the literature search.

groups). Fifty-three articles (63.9%) defined patient complexity by integrating both medical and non-medical aspects (Tables 2–4), among which 28 used a specific tool, and seven a conceptual model.

#### *Patient complexity based on medical aspects, using a tool (Table 1)*

The CCI was used to define patient complexity in six articles and in several ways (e.g., number of points and number of comorbidities).<sup>7,28–32</sup> One article combined this index with the number of medications and the Medication Regimen Complexity Index.<sup>32</sup> Two studies in inpatients with hip or knee operation used the CCI together with the American Society of Anaesthesiology (ASA) score.<sup>30,31</sup> One of these studies completed the assessment of complexity with the Elixhauser score and Diagnostic-Related-Groups (DRGs), distinguishing between illness severity DRGs and mortality risk DRGs.<sup>31</sup> DRGs allow standardization of inpatient costs and reimbursement, and were used in two other articles.<sup>33,34</sup> In the inpatient setting, two studies used the Case Mix Index (CMI), which is defined as the average relative DRG weight of a hospital's discharges, and determines patient clinical complexity and resource needs.<sup>35,36</sup>

Huysse et al. used the COMPLEXedex algorithm, which identifies four categories of complexity based on International Classification of Diseases (ICD)-9 codes (no chronic disease, minor chronic disease, major chronic disease, and system failure).<sup>37–39</sup> Two additional tools were used in individual articles. The diagnostic cost group-hierarchical conditions categories build on age, sex, and ICD-9 diagnoses to summarize healthcare problems and predict future healthcare costs.<sup>40</sup> The medically complex impairment code within the Uniform Data System for Medical Rehabilitation (UDS<sub>MR</sub>) encompasses a variety of conditions in patients with complex and multiple diagnoses.<sup>9</sup>

#### *Patient complexity based on medical and/or non-medical aspects, without tool or model (Table 2)*

The studies included in this group highlighted the interplay between medical conditions and non-medical dimensions. General practitioners defined a complex patient as “a patient for whom decision-making and required care process are not routine, and for whom they need more time to achieve the same level of care as less clinically complex patients,” specifying four domains contributing to complexity (care coordination, patient characteristics, mental health issues,

**Table 1.** Definition of patient complexity according to multimorbidity, with tool ( $n = 15$ ).

First author/ year	Design	Sample/setting	Definition of complexity
Werner/2008 <sup>40</sup>	Retrospective cohort	35,925 Veterans	Diagnostic cost groups-hierarchical conditions categories, including age, sex, ICD-9 diagnoses
Legler/2011 <sup>7</sup>	Cross-sectional	27,166 pat., SEER-Medicare database	CCI ( $\geq 2$ points)
Pino/2011 <sup>33</sup>	Observational	75 intensive care pat.	DRGs
Bayliss/2012 <sup>28</sup>	Cross-sectional	961 older pat., $\geq 3$ conditions	CCI ( $\geq 3$ comorbidities)
Morello/2016 <sup>32</sup>	Retrospective cohort	99 pat., 56 controls	CCI, medication count, medication regimen complexity index
Hewner/2014 <sup>38</sup>	Retrospective cohort	4,11,407 pat.	COMPLEXedex
Hewner/2016 <sup>39</sup>	Retrospective cohort	2868 admissions	COMPLEXedex
Hewner/2016 <sup>37</sup>	Retrospective cohort	7249 admissions	COMPLEXedex
Ramey/2016 <sup>9</sup>	Chart review	682 rehabilitation inpat.	Complex impairment codes based on UDS <sub>MR</sub>
Lepelley/2018 <sup>29</sup>	Chart review	1,592,383 admissions	CCI ( $\geq 2$ comorbidities)
D'Agostino/2019 <sup>34</sup>	Prospective cohort	2190 medical and surgical inpat.	DRGs
Hecht/2019 <sup>30</sup>	Retrospective cohort	177 hip fracture inpat.	CCI and ASA score
Mell/2019 <sup>35</sup>	Quality improvement	144 inpat., carotid revascularization	CMI
Rieg/2019 <sup>36</sup>	Cross-sectional	479 inpat.; infection	CMI
Rudy/2019 <sup>31</sup>	Retrospective cohort	3542 inpat.; hip or knee arthroplasty	CCI, Elixhauser score, ASA score, DRGs illness severity/mortality risk

ASA = American Society of Anesthesiology score; BC = British Columbia; CCI = Charlson Comorbidity Index; DRGs = Diagnostic-Related Groups; ICD = International Classification of Diseases; inpat. = inpatients; NA = not applicable; pat. = patients; UDS<sub>MR</sub> = Uniform Data System for Medical Rehabilitation; CMI = Case mix index.

Articles are presented in alphabetical order by year of publication. If not specified, the publication referred to outpatient setting. COMPLEXedex is an algorithm hierarchizing chronic diseases, and complexity segments, using International Classification of Diseases-9 codes.

and socio-economic factors).<sup>1</sup> This definition correlated little with comorbidity scales.<sup>1</sup> Three other authors emphasized as well the time-consuming effect and the lack of standard care in patient complexity.<sup>41–43</sup> Peek et al. considered symptom severity, diagnostic uncertainty, lack of social safety, disorganization of care, and difficult patient-clinician relationship,<sup>18</sup> while Berry-Milled et al. identified complex patients as those with complex healthcare needs, multiple chronic conditions, many medications, multiple providers, frequent hospitalizations, and limitations of own abilities.<sup>5</sup> Factors contributing to patient complexity mentioned in other articles included age, cognitive decline, psychiatric disorders, patient behaviors (e.g., demanding, argumentative, and anxious), and episodic illness needing support.<sup>12,13,17,44–50</sup>

Two studies focused on factors contributing to complexity during rehabilitation. The first one identified the number of domains influencing the situation, the number of different factors within a domain, the interrelationships of domains and factors, the number of and interrelationships

between interventions, and the number of different professions and organizations involved.<sup>51</sup> The second one defined patient complexity in stroke rehabilitation patients based on medical and functional factors, social determinants, social support, patient personal characteristics, healthcare factors, housing situation, difficulties to discharge, and discharge destination.<sup>23</sup>

### Definition of complexity based on medical and/or non-medical aspects, using a tool (Table 3)

We identified two types of tools: (1) explicitly developed to assess patient complexity and (2) originally used in a different context. The INTERMED system, used in 22 studies,<sup>11,52–71</sup> was developed to standardize identification of patients requiring complex interdisciplinary care due to biopsychosocial aspects, enhance interdisciplinary communication, and describe case complexity in relation to healthcare resource needs. It evaluates biological, psychological, social, and healthcare domains in the context of

**Table 2.** Definition of patient complexity based on medical and non-medical aspects, without tool or model ( $n = 18$ ).

First author/year	Design	Sample/setting	Definition of complexity
Nardi/2007 <sup>48</sup>	Narrative review	NA	≥2 systems (body-diseases, family-socioeconomic status, therapies, frailty, physical decline) intricated
Weiss/2007 <sup>43</sup>	Working-group deliberations	NA	Patients with not routine/standard clinical decision-making and required care process
Fung/2008 <sup>41</sup>	Cross-sectional	15,709 pat.	More time/effort for same levels of care
Berry-Millett/2009 <sup>5</sup>	Narrative review	NA	Multiple conditions/drugs/providers, ability limitation, frequent hospitalizations
Peek/2009 <sup>18</sup>	Expert opinion	NA	Interference with standard care and decision-making
Grant/2011 <sup>1</sup>	Prospective cohort, discussion groups	40 physicians, 120 pat.	Not routine or standard decision-making/care process
Wade/2011 <sup>51</sup>	Editorial	NA	Interrelation between domains, factors within domain, interventions, professions and organizations
Kuluski/2013 <sup>47</sup>	Cross-sectional	116 rehab. pat.	Functional, social +/- mental health issues
Zulman/2014 <sup>17</sup>	Narrative review	NA	Comorbidities interrelated + environment, socio-economics, culture, biology, behavior
Cohen/2015 <sup>45</sup>	Survey; cohort study	survey: 6 physicians, 375 pat.; cohort: 82,247 pat.	Medical, social and behavioral factors
Mercer/2015 <sup>13</sup>	Quality improvement	24 pat.	Medical/social/behavioural complexity
Loeb/2015 <sup>50</sup>	Interviews and review	15 physicians	≥2 chronic interrelated conditions + other factors (age, sex, psychosocial issues, ...)
Mount/2015 <sup>42</sup>	Discussion groups	12 PCPs, 267 pat.	Patient routinely requiring more resources/time or don't follow treatment instructions
Roberts/2015 <sup>49</sup>	Quasi-experimental	198 pat.	≥5 chronic conditions and social complexity
Grudniewicz/2016 <sup>12</sup>	Scoping review	NA	>1 chronic condition or a complex chronic illness affecting >1 health dimension
Nelson/2016 <sup>23</sup>	Discussion groups	15 physicians, 18 nurses (neuro-rehab.)	More difficult to treat/discharge. Aspects: Medical/functional; social; social/family support; personal; health system
Gallagher/2017 <sup>46</sup>	Retrospective cohort	17 high utilization pat.	≥3 domains from DSM (qualitative assessment)
Bail/2018 <sup>44</sup>	Retrospective cohort	157,178 inpat.	Old, high comorbidity level, functional/cognitive support needs, acute illnesses

DSM = Diagnostic and Statistical Manual of Mental disorders; inpat. = inpatients; NA = not applicable; pat. = patients; PCP = primary care physician; rehab. = rehabilitation.

Articles are presented in alphabetical order by year of publication. If not specified, the publication referred to outpatient setting.

time (history, current state, and prognosis), and scores 20 items between 0 (no symptom) and 3 (severe symptom). More than 20 out of 60 points usually indicates complexity. Two studies used the Patient Centered Assessment Method (PCAM), which was developed based on INTERMED, and includes health and well-being, social environment, health literacy and communication, and service coordination.<sup>72,73</sup> This tool is intended to assist medical staff in referring multimorbid patients with psychosocial needs.

The medication therapy management (MTM) Spider Web, including clinical problems, comorbidities, complications, and socio-economic and behavioral characteristics, was developed as a teaching tool to synthesize medical and non-medical information, and evaluate and prioritize problems to establish patient-centered care plans.<sup>74</sup> The extended version of the Rehabilitation Complexity scale quantifies care, special nursing and medical requirements, and the need for specific disciplines and assistive devices during rehabilitation.<sup>75</sup> The Potential Benefit Scale is based on patient-reported measures and contains five features

(comorbidity severity, physical function, mental health, disease specific burden, and passive approach to health-care).<sup>76</sup> The adjusted Clinical Group from John Hopkins quantifies morbidity by grouping individuals based on age, sex, and medical diagnoses recorded over a defined time period.<sup>77</sup> Finally, the Danish Deprivation Index includes only social and economic issues.<sup>78</sup>

#### *Definition of complexity based on medical and/or non-medical aspects, using a conceptual model (Table 4)*

All models incorporated both medical and non-medical aspects. *Safford* et al. designed a theoretical Vector Model in which each vector represents one domain (socio-economic, culture, biology/genetics, behavior, and environment).<sup>24</sup> All vectors are added to form a final vector the direction of which indicates the degree of complexity and demonstrates domain interrelatedness. *Schaink et al.* highlighted three entangled main determinants of

**Table 3.** Definition of patient complexity based on medical and non-medical aspects, with tool ( $n = 28$ ).

First author/year	Design	Sample/setting	Definition of complexity
Huyse/1997 <sup>58</sup>	Editorial	NA	INTERMED
Stiefel/1999 <sup>65</sup>	Prospective cohort	102 pat. with low back-pain	INTERMED
Fischer/2000 <sup>57</sup>	Comparative study	61 pat.	INTERMED
Koch/2001 <sup>59</sup>	Prospective cohort	85 rheuma pat.	≥21 points on INTERMED
de Jonge/2002 <sup>54</sup>	Cross-sectional	43 in- and outpat. with somatic complaints	INTERMED
de Jonge/2003 <sup>55</sup>	Validity study	1032 pat.	INTERMED
Di Gangi/2003 <sup>56</sup>	Prospective cohort	31 women with urinary tract symptoms	≥21 points on INTERMED
de Jonge/2004 <sup>52</sup>	Prospective cohort	70 pat.	≥20 or 21 points on INTERMED
de Jonge/2005 <sup>53</sup>	Review	NA	≥20 or 21 points on INTERMED
de Jonge/2006 <sup>11</sup>	Review	NA	INTERMED
Huyse/2006 <sup>70</sup>	Review	NA	INTERMED
Stiefel/2006 <sup>66</sup>	Review, expert opinion	NA	≥20 points on INTERMED
Latour/2007 <sup>60</sup>	Practice article	NA	≥21 points on INTERMED
Stiefel/2008 <sup>71</sup>	RCT	247 rheuma inpat.	≥20 points on INTERMED
Lobo/2011 <sup>61</sup>	Cross-sectional	43 pat.	≥21 points on INTERMED
Wild/2011 <sup>69</sup>	Group interviews	42 older inpat.	≥21 points on INTERMED
Olsen/2012 <sup>78</sup>	Model creation	Practitioners data	Danish Deprivation Index
Malik/2013 <sup>76</sup>	Cross-sectional	1314 pat. with diabetes	Potential benefit scale (weighted mean of TIBI, PFI-10, CES-D, diabetes burden scale, PDHCO)
Morello/2013 <sup>74</sup>	Teaching article	NA	MTM spider web (comorbidities, drugs, socio-economics, behavior)
Peters/2013 <sup>64</sup>	Cross-sectional	338 older pat.	≥21 points on INTERMED, self-rated
Angstman/2014 <sup>77</sup>	Chart review	1894 primary care pat. with depression or dysthymia	Adjusted clinical group from Johns Hopkins (measures morbidity burden based on disease patterns, age, sex)
Ludwig/2014 <sup>62</sup>	Clinical trial	119 transplant candidates	INTERMED
Meller/2015 <sup>63</sup>	Retrospective validity study	66 pat. with triple diagnoses	≥21 points on INTERMED
Pratt/2015 <sup>72</sup>	Prospective cohort; qualitative study	cohort: 286 pat.; qualitative study: 243 pat.	PCAM
van Eck van der Sluijs/2017 <sup>67</sup>	Cross-sectional	187 pat., somatic symptom disorder	≥20 points on INTERMED
van Reedt Dortland/2017 <sup>68</sup>	Prospective cohort	850 pat.	≥21 points on INTERMED
Yoshida/2017 <sup>73</sup>	Prospective cohort	201 inpat.	PCAM and INTERMED
Schiavi/2018 <sup>75</sup>	Cross-sectional	16 inpat. with stroke	>9/22 points on extended version of rehabilitation complexity scale (includes dependence in ADL, special nursing care and daily monitoring needs)

ADL = activities of daily living; CES-D = Epidemiologic Studies Depression Scale; inpat. = inpatients; INTERMED = Integrated Medicine; MTM = Medication Therapy Management; NA = not applicable; pat. = patients PCAM = Patient Centered Assessment Method; PDHCO = Provider Dependent Health Care Orientation scale; PFI-10 = Physical Function Scale; RCS-E = Rehabilitation Complexity Scale Extended version; rheuma. = rheumatological; TIBI = Total Illness Burden Index.

Articles are presented in alphabetical order by year of publication. If not specified, the publication referred to the outpatient setting. INTERMED includes history, current state, and prognosis for four domains (biological, psychological, social and healthcare domains). PCAM includes four domains: (1) health and well-being, (2) social environment, (3) health literacy and communication, (4) action.

complexity (multimorbidity, psychosocial vulnerability, and healthcare utilization), and developed a model including five health dimensions (medical/physical health, mental health, demographics, social capital, health, and social experiences).<sup>25</sup>

Three authors developed more patient-centered models. The first one foregrounded the imbalance between patient workload and coping capacities, emphasizing the dynamic of complexity.<sup>26</sup> The second one combined patient-centered and psycho-biological aspects in the “Cycle of Complexity,”

**Table 4.** Definition of patient complexity based on medical and non-medical aspects, using a conceptual model ( $n = 7$ ).

First author/year	Design	Sample/setting	Definition of patient complexity
Safford/2007 <sup>24</sup>	Model development	NA	Vector complexity model: Biology/genetics, culture, socio-economics, environment/ecology, behavior
Eton/2012 <sup>16</sup>	Semi-structured interviews	32 outpatients	Complex self-care regimen (coping with $\geq 1$ chronic condition + polypharmacy); dynamic and complicated by patient experience (social, clinical, personal)
Schaink/2012 <sup>25</sup>	Scoping review	NA	Domains: Demographics, medical/physical/mental health, social capital, health/social experiences
Shippee/2012 <sup>26</sup>	Narrative review	NA	Dynamic state; patient experience (social, clinical, personal) as complicating factor
Grembowski/2014 <sup>22</sup>	Review, expert opinion	NA	Gap between individual needs and healthcare services capacity
Zullig/2016 <sup>27</sup>	Narrative review	NA	Complicated interplay between medical and non-medical factors
Miller/2019 <sup>79</sup>	Cross-sectional	167 pat., urban managed care network	Activation and coordination team framework; patient complexity integrates demographics, health, social aspects, health literacy

NA, not applicable; pat. = patients.

Articles are presented in alphabetical order by year of publication. If not specified, the publication referred to outpatient setting.

demonstrating the interplay between medical and non-medical issues.<sup>27</sup> The third one developed a conceptual framework to measure treatment burden in complex patients, describing three main interrelated determinants, based on patient experiences: work of self-care (e.g., learning about the disease), facilitating strategies (e.g., social support), and exacerbating factors (e.g., acute illness).<sup>16</sup>

One article defined complexity as the gap between an individual's needs and the capacity of healthcare services to answer those needs, and illustrated this in the Agency for Healthcare Research and Quality and Multiple Chronic Conditions Research Network (AHRQ MCCRN) Conceptual Model, developed for healthcare quality improvement.<sup>22</sup> Miller *et al.* developed the Activation and Coordination Team (ACT) framework, which integrates patient complexity (demographic characteristics, mental and physical health, social environment, and health literacy) with intervention strategies (e.g., patient support), proximal outcomes (patient activation and self-care management) and distal outcomes (e.g., quality of life, utilization, and cost).<sup>79</sup> This framework further uses medical and social complexity criteria to classify patients into four quadrants (wellness care, medically complex, socially complex, and medically and socially complex).

#### *Patient complexity according to medical aspects, without tool or model (Table 5)*

In 12 articles, complexity was used interchangeably with the terms multimorbidity, polymorbidity, or comorbidity, or defined according to a particular number of diseases (usually more than two to three conditions).<sup>3,6,8,10,14,15,19, 80–84</sup> Among these, one definition used either  $\geq 2$  cardiometabolic or  $\geq 3$  non-cardiometabolic chronic conditions,<sup>15</sup> whereas two definitions

required the presence of specific diseases: any combination of cardiovascular disease, chronic kidney disease or diabetes mellitus in the first definition,<sup>8</sup> and diverse and multiple diagnoses, (including diabetes, cancer, HIV, neurological disorders, autoimmune diseases, physical disabilities, and severe mental illnesses) in the second one.<sup>14</sup> Two articles used the concept of “complex multimorbidity,” defined as the co-occurrence of  $\geq 3$  chronic conditions affecting  $\geq 3$  different body systems,<sup>3,10</sup> while another emphasized the importance of stage of illness (more specifically advanced illness) in addition to comorbidities.<sup>82</sup> Greater challenge to achieve quality goals,<sup>19</sup> and higher risk of future hospitalization,<sup>6</sup> in combination with multimorbidity, were mentioned as parameters contributing to complexity in two individual articles. Three articles described complexity according to medical aspects other than the number of diseases, with their definitions based on polypharmacy,<sup>85</sup> number of nursing diagnoses,<sup>86</sup> or severity of injuries.<sup>87</sup>

## Discussion

To our knowledge, this is the first review to provide a detailed description of the definitions of patient complexity used in the last 25 years. The definitions among the 83 articles included were extremely heterogeneous. Some authors limited the assessment to medical factors, (most often a number of conditions), while others expanded their definition to non-medical aspects. A substantial number of articles used a tool (e.g., index and algorithm) or a conceptual model to describe patient complexity. Few studies were designed to explicitly investigate or define patient complexity, and most articles referred to the outpatient setting.

This review revealed several important findings.

**Table 5.** Definition of patient complexity based on medical aspects, without tool or model ( $n = 15$ ).

First author/year	Design	Sample/setting	Definition of complexity
Taheri/1999 <sup>87</sup>	Cross-sectional	692 trauma discharges	Severe injuries
Luck/2007 <sup>14</sup>	Narrative review	NA	Multiple diagnoses (diabetes, cancer, HIV, autoimmune or neurological disease), physical/mental disability
Noël/2007 <sup>81</sup>	Cross-sectional survey	422 pat., 8 VHA primary care clinics	≥2 chronic illnesses
Sweeney/2007 <sup>82</sup>	Prospective cohort	756 pat. of HMO	Advanced illness and multiple comorbid disease states
Werner/2007 <sup>19</sup>	Review and expert opinion	NA	Multiple conditions with greater challenges to achieve quality goals
Tsasis/2008 <sup>83</sup>	Expert opinion	NA	≥2 chronic diseases simultaneously
Levin/2009 <sup>8</sup>	Retrospective cohort	BC ministry of health database	Any combination of CVD, CKD and diabetes
Maciejewski/2009 <sup>15</sup>	Retrospective cohort	7933 Veterans	≥2 cardiometabolic conditions or ≥3 chronic conditions
Newcomer/2011 <sup>80</sup>	Retrospective cohort	15,480 pat.	≥2 chronic interacting diseases
Flottemesch/2012 <sup>85</sup>	Retrospective cohort	58,391 pat.	≥7 medications
Weber/2012 <sup>84</sup>	Randomized controlled trial	139 pat.; CKD and diabetes +/- CVD	≥2 conditions
Harrison/2014 <sup>3</sup>	Cross-sectional	290 physicians, 8707 pat	Complex multimorbidity: ≥3 chronic conditions, ≥3 body systems
Wallace/2015 <sup>10</sup>	Clinical review	NA	Complex multimorbidity: ≥3 chronic conditions, ≥3 body systems
Castellan/2016 <sup>86</sup>	Prospective cohort	100 intensive care pat.	≥19 diagnoses nursing diagnoses
Horn/2016 <sup>6</sup>	Quasi-experimental	1547 pat.	Multiple chronic conditions with high risk for hospitalization

BC = British Columbia; CKD = chronic kidney disease; CVD = cardiovascular disease; HIV = Human Immunodeficiency Virus; HMO = Health Maintenance Organization; NA = not applicable; pat. = patients; VHA = Veterans Health Administration.

Articles are presented in alphabetical order by year of publication. If not specified, the publication referred to outpatient setting.

First, several articles used the terms multimorbidity, polymorbidity, or comorbidity interchangeably with complexity, or limited the definition of complexity to a number of medical conditions. However, there was a notable lack of consensus on the number and type of conditions to include. Even the use of a tool did not remove heterogeneity, due to the various ways that the tools were used (e.g., count of number of points or of comorbidities in the CCI). Moreover, the tools based on chronic conditions were not originally developed to assess patient complexity. Although chronic conditions represent an important aspect of patient complexity, defining patient complexity based solely on medical aspects does not account for several other factors, and would not reflect general practitioners' perspectives of patient complexity.<sup>1</sup> Furthermore, complexity can exist in the absence of multimorbidity; for example, when there is a language barrier, or when patients are time-consuming, while a patient with multiple conditions is not per se complex.<sup>1,12,23,42,43</sup>

Second, almost two-thirds of the articles included non-medical aspects to define patient complexity. Central aspects of these definitions were the high degree of patient individuality, the dynamic of complexity, and the interrelation between different domains, such as interactions of diagnostic procedures or interventions, various treatment

strategies, multiple healthcare providers, or chronic conditions with positive or negative mutual influence.<sup>17,76</sup> In this context, we also identified contradictory statements. For example, several authors claimed that diabetes itself enhances complexity, while another author pointed out that close follow-up of patients with diabetes would help better control comorbidities, so that diabetes diagnosis may actually reduce patient complexity.<sup>8,15,76</sup> This underscores that patient complexity is partly practitioner-dependent. The interrelationships between the different domains of those definitions were illustrated in conceptual models, which may offer a more holistic approach than other definitions.

Third, we identified several tools that included medical and non-medical aspects to assess complexity, which is a more systematic way to improve comparability across studies. The INTERMED is probably the best studied validated and reliable tool for this purpose.<sup>65,66</sup> The MTM Spider Web is another interesting instrument, showing that patient complexity is also a challenge for pharmacists, and that medication regimen should not be neglected when assessing complexity.<sup>74</sup> Further tools or conceptual models prioritized healthcare use assessment to determine patient complexity,<sup>22,76,77</sup> but it remains unclear



whether higher healthcare utilization refers inevitably to complexity.<sup>25</sup> Tools and conceptual models identified in this review seem to serve different purposes, and thus might be used to assess different outcomes. Although tools can help healthcare providers to rapidly establish the level of patient complexity, conceptual models offer a more holistic approach that may nevertheless be less practical.

Fourth, we identified several domains that can increase complexity, but that may be difficult to assess in a standardized way or in clinical routine.<sup>24</sup> These included educational status, cognitive or functional decline, missed appointments, abuse, mental disorders, lack of coping strategies, patient preferences diverging from those of providers, or reduced adherence. According to Zullig et al., considering patient preferences would be particularly important, but is frequently missing in the evaluation of patient complexity.<sup>27</sup> Furthermore, the potential effect of relatives on an individual's capacity to manage their health was rarely part of the definitions.<sup>24,26</sup> Moreover, it is worth mentioning that literature on patient complexity identified in this review mostly comes from high-income countries, while the topic seems to remain underexplored in low- or middle-income the countries. It would be interesting to study which aspects of complexity are similar or differ between low-, middle-, and high-income countries. Finally, the concept of frailty, which has several validated measures and is likely to impact complexity, was rarely part of the definitions.<sup>48</sup>

Finally, there was great heterogeneity across definitions of patient complexity, while some authors even wrote about patient complexity without providing any definition.<sup>88–98</sup> Developing and using a more standardized definition of patient complexity that can also help to identify complex patients in clinical practice may ease study comparison. However, it may not be achievable or desirable, since patient complexity is to a certain extent context- and practitioner-dependent. Furthermore, complexity is a dynamic state which may fluctuate with the change in illness severity and impact of functioning, for example. This may make its assessment even more difficult. Nevertheless, recognizing patients with complex needs may improve decision-making, care coordination and follow-up, which could contribute to reducing emergency department visits and hospitalizations,<sup>21</sup> and, therefore, also to reducing potentially inappropriate healthcare costs. Furthermore, in the inpatient setting, early detection of complex patients could allow for better discharge planning, and thus help prevent complications after hospitalization.

### **Strengths and limitations**

We must mention some limitations to our review. First, the literature search was performed in PubMed only.

Nevertheless, we broadened the search to references of included articles, and identified multiple publications comprising a broad spectrum of definitions of patient complexity, which thus allowed us to answer our research question. We therefore decided not to extend the search to an additional database. Second, we did not assess the quality of the articles, but this was not possible because of the wide variety of publications included in the review. Third, we focused on adults, so that our results may not be generalizable to the pediatric population, in which other aspects may contribute to patient complexity, and multimorbidity likely plays a less important role.

Our study presents several strengths also. First, we reviewed over 25 years of the literature including a definition of patient complexity. Second, we used a systematic search strategy with broad terminology, thereby minimizing the risk of missing relevant publications. Third, all uncertainties were discussed among the authors. Finally, we not only described but also categorized the definitions, which provides a more systematic way of summarizing and presenting relevant information.

### **Conclusion**

In summary, this review found that patient complexity was extremely heterogeneously defined across the publications. A standard definition for a concept so frequently used in the medical literature is lacking. Patient complexity definition was frequently based on chronic conditions only, although non-medical aspects and interrelationships between various medical and non-medical domains seem to play a key role in patient complexity. A holistic approach including biopsychological, cultural, socio-economic, and environmental factors, as well as patient perspectives, seems therefore the most appropriate. Given the important healthcare challenges set by complex patients, and since identifying such patients could help to improve care and allow better resource allocation, further research should develop and use a standardized definition applicable in clinical practice and to allow for comparison across studies.

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### Authors' note

Complex patients represent a challenge for healthcare systems and providers. We reviewed patient complexity definitions, and found great heterogeneity in the definitions. There is a need to standardize the definition to allow study comparability and identification of complex patients in practice to help improve their care.

### Author contributions

JDD designed the study. BC, SN and CEA performed the literature search, including articles search and data abstraction. BC, SN and CEA drafted the manuscript. All authors read and approved the final manuscript.

### ORCID iD

Carole E Aubert  <https://orcid.org/0000-0001-8325-8784>

### Supplemental material

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