Review

Measuring health equity in emergency care using routinely collected data: a systematic review

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Abstract: Identifying health care equity indicators is an important first step in integrating the concept of equity into assessments of health care system performance, particularly in emergency care. We conducted a systematic review of administrative data-derived health care equity indicators and their association with socio-economic determinants of health (SEDH) in emergency care settings. Following PRISMA-Equity reporting guidelines, Ovid MEDLINE, EMBASE, PUBMED and Web of Science were searched for relevant studies. The outcomes of interest were indicators of health care equity and the associated SEDH they examine. Among 29 studies identified, 14 equity indicators were identified and grouped into four categories that reflect the patient emergency care pathway. Total emergency department (ED) visits and ambulatory care sensitive condition-related ED visits were the two most frequently used equity indicators. Despite some conflicting results, all identified SEDH (social deprivation, income, education level, social class, insurance coverage and health literacy) are associated with inequalities in access to and use of emergency care. In conclusion, the use of administrative data-derived indicators combined with identified SEDH could improve healthcare equity measurement in emergency care settings across health care systems worldwide.

Keywords: health equity; emergency care; determinants of health

1. Introduction

The World Health Organization defines equity as *"the absence of avoidable, unfair, or remediable differences among groups of people, whether those groups are defined socially, economically, demographically or geographically or by other means of stratification"*.[1] Applied to health care, equity means guaranteeing the "distribution of care in such a way as to get as close as feasible to an equal distribution of health".[2]

These definitions imply two essential components of equity: horizontal equity (same care for the same health need) and vertical equity (different care for different needs).[3] To analyse equity within the health care system, most researchers assume that vertical equity is on average satisfied and focus their analysis on horizontal equity, i.e. inequalities in the use of the health care system for the same health needs.[4]

However, achieving equity in health care remains a challenge for health care systems worldwide.[5–7] Several recent studies raise the importance of addressing the concept of equity when making decisions about health care policies and practices.[8–10] However, the health care system's performance assessment has traditionally been limited to quality and efficiency indicators, and health care decision-makers remain poorly informed about

equity,[8] particularly in emergency care.[10] Measuring and monitoring equity is, therefore, an emerging area of interest in assessing emergency care performance.[10–13]

Emergency care is a unique health care setting as it is situated at the interface of outpatient (ambulatory) care and inpatient (hospital-based) care. Identifying health care equity indicators in this setting makes it possible to assess both access to outpatient care while also highlighting differences in quality of care within hospital-based care.[14,15]

Several approaches and data could be used to ensure accessibility of quality data on relevant variables for measuring health care equity, from primary qualitative or quantitative data to routinely collected administrative data. For this study, we have decided to focus on studies based upon routinely collected administrative data. It has two fundamental advantages in the analysis of health care equity: the achievement of near-complete coverage of the target population and the possibility of disaggregation in subpopulations. Moreover, using administrative data minimises cost and burden of response.[16]

Finally, for this review, we have focused our analysis on studies measuring equity through socio-economic determinants of health (SEDH), i.e., education, financial resources, social and material living conditions. [17,18]

This systematic review aims to identify how health care equity is measured by combining administrative data-derived emergency care equity indicators and SEDH to create a set of valuable and replicable indicators that can be used in the identification and analysis of health care equity in emergency care settings.

2. Materials and Methods

The protocol of this systematic review was published in PROSPERO at the outset of the study. (See Supplementary Materials, **File S1**) The reporting of this systematic review was based on the PRISMA-equity guidelines.[19] (See Supplementary Materials, **File S2**)

2.1 Inclusion/Exclusion Criteria

We included studies reporting on health care equity indicators, which were analysed as such, focusing on studies that used administrative data and were conducted in emergency care settings in high-income countries. As this systematic review's objective is to focus on health care equity in the context of emergency care and not to identify inequalities in emergency care provision between countries, a focus was placed on studies conducted in high-income countries. It is indeed tricky, in countries where health care resources are often lacking or insufficient, to determine whether variations in the use of care amongst specific populations are linked to inequities in access to care or whether they are the result of an overall lack of resources in the health care system. We included studies on adults (age 18 and over). If a study included both children and adults, we limited data extraction to data pertaining only to adults. We included studies regardless of whether a disease-specific focus was taken (for example cancer, chronic diseases or mental health). Searches were limited to English, German, French, and Italian (due to the authors' language skills) published between January 2010 and January 2019. We chose to focus on studies published after 2010 because of the significant evolution of health care equity-related literature that followed the WHO Report "Closing the gap in a generation: Health equity through action on the social determinants of health".[20]

We limited our analysis to studies looking at inequities and their associated SEDH as defined above, excluding studies looking at determinants of health such as race/ethnicity, gender or place of residence to ensure consistency and comparability between studies and countries.[4][18]

We excluded studies that did not focus on equity, as well as opinion papers, editorials, conference abstracts and study protocols.

2.2 Search Strategy

The search strategy was conducted with a medical librarian's assistance using four databases: Ovid MEDLINE, EMBASE, PubMed and Web of Science. We used keywords in the field of equity, socio-economic factors and emergency care. We combined the Medical Subject Headings (MeSH) terms "Health Services Accessibility", "Health Equity" or "Health care Disparities" with a combination of terms defining administrative data and with text words "emergency department" or "emergencies". Initial searches were conducted in November 2018 to assess the scope of the literature. The last search was conducted in January 2019. The full search strategy can be found in Supplementary Materials. (See Supplementary Materials, **File S3**)

Following the initial search, we screened reference lists of all included studies and performed Google and Google Scholar searches using key search terms to identify any further relevant studies that were not initially captured or had not yet been published.

2.3 Study Selection

Two reviewers (KM, XL) conducted screening of articles independently and in duplicate. It was done in two stages: screening all titles and abstracts and reviewing all relevant articles' full-text to determine their final analysis eligibility. Two other reviewers (JM, PB) provided arbitration in the event of a disagreement at both screening stages. Reasons for exclusion of articles at the full-text screening stage were documented.

2.4 Data Extraction

Two authors (KM, XL) extracted data independently and in duplicate from included studies using Rayyan® (free online systematic review management system) and any discrepancies were resolved by consulting the two other reviewers (JM, PB). Data on the studies' critical characteristics were extracted in a predefined data extraction form, into an Excel® spreadsheet, including information about the design of the study, population, type of data, indicators of health care equity, SDEH addressed, main findings and key conclusions.

2.5 Quality and Bias Assessment

Risk of bias was assessed using the validated checklist published by the US National Heart, Lung and Blood Institute (NIH) for observational cohort and cross-sectional studies. [21]. This tool is composed of 14 questions and well-described guidance for the bias assessment. It has been recently recommended in a review for the assessment of both observational cohort and cross-sectional studies. [22]

2.6 A conceptual framework for the analysis

To address equity, we based our analysis on a conceptual framework of access to health care, developed by Levesque and al.[23] This framework combines five dimensions of accessibility (approachability, acceptability, availability/accommodation, and affordability/appropriateness) with five corresponding abilities of the target population (ability to perceive, seek, reach, pay, and engage). It provides a comprehensive approach to health care equity and the different factors that could impact it. **(Figure 1)**

We will use this framework to structure data extraction.
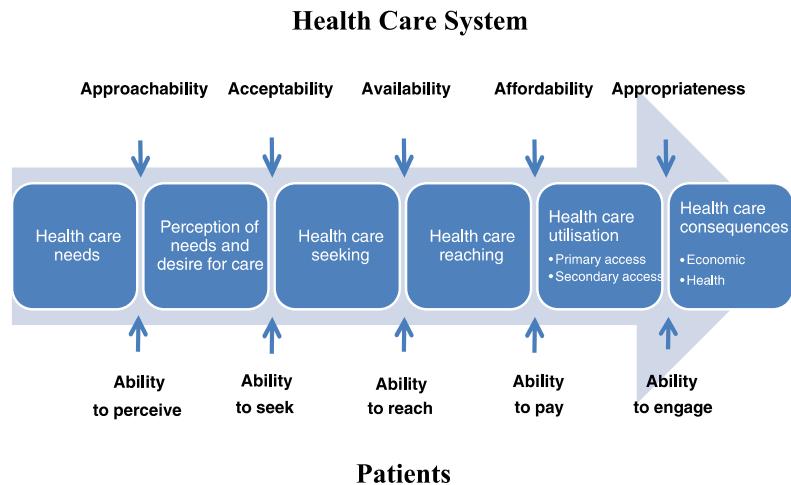
Figure 1. Framework of health care equity, adapted by Levesque et al.
This figure represents the various potential barriers of access to care from the perspective of the health care system and of the patients. (Adapted from the conceptual framework developed by Levesque et al. with the authors' permission)

3. Results

3.1 Study inclusion

The initial search yielded 354 papers, of which 29 were included in the final analysis. **(Figure 2)** Of these, 17 (59%) were conducted in the United States (US), 5 (17%) in the United Kingdom (UK), 3 (10%) in Canada, 2 (7%) in Australia, 1 (3%) in Sweden and 1 (3%) in Switzerland. Twenty-eight (97%) were written in English, and one (3%) in French. A detailed description of each study is presented in Supplementary Materials **(Table S1)**.
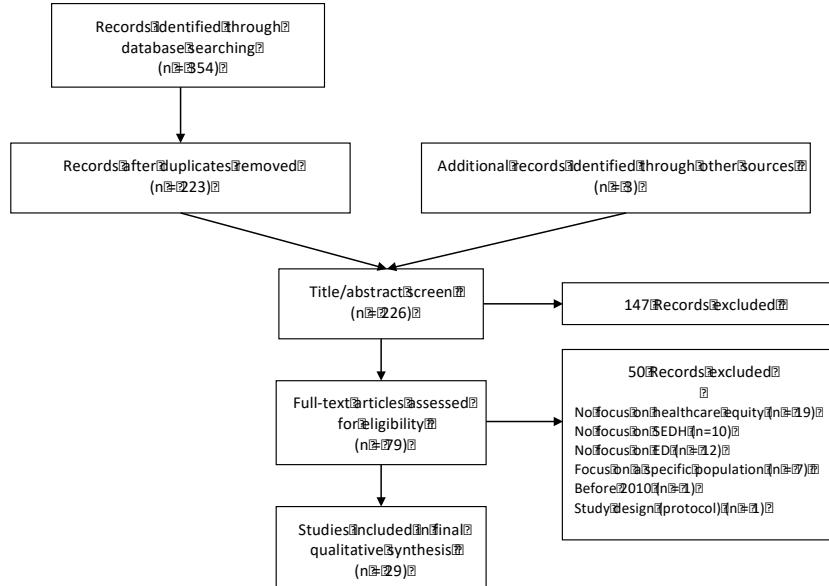

Figure 2. Flow diagram of literature research

3.2 Risk of bias assessment

The NIH quality and risk of bias assessment tool used made it possible to evaluate the internal validity of the selected studies in this review. Of the 29 studies, 28 are considered fair, and one study is considered poor, mainly due to the lack of statistical analysis of confounding factors. The detailed assessment is available in Supplementary Materials **(Table S2)**.

Moreover, the bias assessment revealed two significant risks of bias across studies. First of all, there is a risk for confounding related to the use of retrospectively collected administrative data used across all included studies as adjustment can only be performed with available collected variables. If potential confounding variables were not collected, they could not be accounted for. For example, the almost systematic absence of precise clinical diagnoses in administrative data undermines the ability to estimate the health of selected populations accurately and therefore, does not allow for a correct adjustment between compared groups.

Secondly, comparisons between studies are biased because, for the same variable, data are not collected in a standardised manner. This information bias concerns all SEDH variables but is particularly relevant for the socio-economic level, often analysed using indices that include many variables that differ between studies.

The significant heterogeneity associated with a large number of outcomes and exposures (our systematic review highlighted 14 different indicators and 7 SEDH) prevented the authors from performing a meta-analysis.

3.3 Equity indicators

The analysis of the 29 articles highlighted 14 different indicators used to assess health care equity. We categorised them into four groups according to the part of the patient care pathway they analysed, inspired by the "5 five dimensions of accessibility" defined in the framework of Levesque et al. [23]:

A.   Equity indicators of poor access to outpatient care (indicators "before emergency care") (Group 1)

B.   Equity indicators of quality of emergency care (indicators "during emergency care") (Group 2)

C.   Equity indicators of clinical outcomes (indicators "following emergency care") (Group 3)

D.   Global Equity indicators (Group 4)

3.3.1   Equity indicators of poor access to outpatient care (Group 1)

This group of indicators analysed outpatient care access through differences in emergency care consumption (inadequate access to outpatient care leading to excess emergency care use). Therefore, they are indirect indicators of access to outpatient care. Five indicators belonged to this group.

- (1) ED visits/Emergency admissions[1] rate

With 26% (n=7) of articles using this indicator, it was the most commonly reported indicator identified in this systematic review.[24–30] It was used to highlight disparities of access to outpatient care. Since both reflect poor access to quality primary care, we have grouped them under the same indicator.

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

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[1] For the purpose of this paper, the term "emergency admissions" is referring to a hospital admission following ED-based care or to a hospital admission for an emergency condition

• (2) Ambulatory care sensitive conditions (ACSCs)[2] ED visits/ACSCs emergency admissions rate

Also called Preventable ED visits/Preventable emergency admissions, this indicator, used in seven articles, is used as often as the previous indicator "ED visits/Emergency admissions rate".[10,25,27,31–34] It is deemed a more specific indicator than "ED visits/Emergency admissions" alone to assess disparities in outpatient care access.

• (3) Frequent ED visits

One study used this indicator considering frequent ED visits when four or more ED visits occurred by an individual per year.[35]

• (4) ED-associated initial diagnosis rate

This indicator compared the rate of initial diagnosis of cancer in the ED between different SEDH.[36]

3.3.2 Equity indicators of quality of emergency care (Group 2)

The second group of health care equity indicators was indicators of quality of emergency care. They characterise disparities of care in the ED among targeted SEDH.

• (5) Emergency specific procedures rate

Emergency specific procedures comprised a combination of different procedures performed during emergency care, highlighting disparities in the quality or access to care for specific emergency conditions such as a brain scan for the diagnosis of acute stroke,(36) reperfusion therapy in acute stroke,[38] and cardiac catheterisation after myocardial infarction or cardiac arrest.[39,40]

• (6) Delay to diagnosis or treatment rate

Two studies focused on disparities in time to a diagnostic procedure (CT scan for stroke)[37] and to definitive treatment (time to permanent pacemaker implementation for emergency cases).[41]

• (7) Missed diagnoses in ED rate

This indicator, used in one study, highlighted disparities of missed diagnoses of acute myocardial infarction according to insurance status or median household income.[42]

3.3.3 Equity indicators of outcome after emergency care (Group 3)

This third group of indicators includes indicators of outcome disparities. We identified six outcome indicators.

• (8) Major adverse event rate

This indicator was used in 2 studies that analysed general emergency surgery.[43,44] It represented the rate of specific complications following a general emergency surgery including cerebrovascular accident, pneumonia, pulmonary embolus, acute respiratory distress syndrome, renal failure, urinary tract infection, myocardial infarction, sepsis, septic shock and cardiac arrest.

• (9) In-hospital mortality and (10) failure to rescue rate

In-hospital mortality was used to reflect the quality of care during emergency care or surgery, as reported in three articles identified in our review.[40,43,44] One distinguishes in-hospital mortality from failure to rescue, which occurs when a patient dies as a result of a major adverse event and seems, therefore, to be more sensitive to assess differences in quality of emergency care or surgery.[43]

• (11) Neurological recovery rate

This specific indicator was used in one study analysing the neurological recovery over time of patients presented to the ED with a cardiac arrest.[40]

• (12) Length of stay/Bed days (after emergency admission)

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[2] ACSCs are conditions for which it is believed that timely and appropriate outpatient care could prevent disease complications, or worsening of disease conditions thereby preventing ED visits and hospital admissions

Although these are traditional hospital care quality indicators, they are used in one study that analysed inequities following emergency admission according to social deprivation.[45]

3.3.4 Global Equity indicators

As they could reflect a lack of outpatient care following a discharge post-admission and poor quality of care during an emergency admission, these following indicators could apply to the three different groups of indicators.

- (13) 30/90/365-day mortality rate

One study analysed 30-/90-/365-day mortality following emergency admission for hip fracture, reflecting the quality of ED- and hospital-based care, as well as access to and quality of ambulatory follow-up care post-discharge.[46]

- (14) ED readmissions rate/Emergency rehospitalisation rate

This indicator was used in three articles. Two of them analysed ED readmissions within 30 days post-discharge.[47,48] One used this indicator to analyse hospital admissions rate through the ED in the year following a diagnosis of breast, colorectal, non-small cell lung or pancreatic cancer.[49]

The different emergency care equity indicators are summarised in **Table 1**.

Table 1. Emergency Care Equity indicators

GROUP 1	GROUP 2	GROUP 3
Access to High-Quality Outpatient Care (ie. Before ED care)	**Quality of Emergency Care** (ie. During ED care)	**Outcome Following Emergency Care** (ie. After ED care)
ED visits/Emergency admissions rate	**Specific procedures rate** (*Including management of ST-elevation myocardial infarction, ischemic stroke, out-of-hospital cardiac arrest*)	**Major adverse events (MAE) rate** (*Specifically following emergency surgery*)
Preventable ED visits/ preventable emergency admissions rate (*ACSCs[3]*)	**ED missed diagnosis rate**	**In-Hospital Mortality rate/Failure to rescue rate** (*After emergency admission*)
ED-associated initial diagnosis rate (*Of cancer, in "emergency presenters"*)	**Delay to diagnosis or treatment rate** (*For emergency conditions*)	**Recovery rate** (*After out-of-hospital cardiac arrest*)
Frequent ED visits rate (*4 or more a year*)		**Length of stay/Bad days** (*After emergency admission*)
ED readmissions rate/Emergency Rehospitalisation rate (*Within 30 days of discharge or during the year after diagnosis of cancer*)		
30/90/365-day mortality rate (*precisely following emergency hip fracture admission*)		

List of the different equity indicators divided into three categories. The first category represents indicators of access to high-quality outpatient care. The second category represents the indicators of quality of emergency care. The last category represents the outcome indicators following emergency care. The two last indicators, because of their broadness are included in the three groups

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[3] ACSCs : Ambulatory Care Sensitive Conditions. Conditions for which timely and appropriate outpatient care can prevent disease complications, more severe disease, or need for hospitalization

3.4   *Socio-Economic Determinants of Health (SEDH)*

The articles included in this review analysed health care equity based on seven SEDH:

Insurance status, social deprivation, income, education level, social class, health literacy and financial and non-financial barriers. (Additional file 4) They covered the five abilities considered by Levesque et al. (Figure 1), as mentioned in brackets and italics at the end of each paragraph.

Overall, the three main SEDH used to analyse health care equity across the 29 included studies were health insurance status, indices of social deprivation and income, and eight studies (28%) used more than one SEDH in their health care equity-focused analysis.

3.4.1   Insurance status

Insurance coverage as a relevant SEDH was approached in diverse ways amongst the 16 articles that used it including comparing outcomes between uninsured and insured individuals,[24,30] between publicly and privately insured individuals,[34,39–41,47,50] or between uninsured, publicly and privately insured individuals.[24,26,36,42–44,48,49] Present in more than half (55%) of the studies analysed, it is the most widely used SEDH in analyses of health care equity identified in this review. (*It reflects the ability to pay in Levesque's framework*).

3.4.2   Social deprivation (indices of area deprivation)

This SEDH represents the diverse social and economic conditions in which people live. This group was composed of different socio-economic deprivation indices including the "Index of Multiple Deprivation"[4],[10,45,46] "Carstairs Index"[5],[32,37] "Index of Marginalization area"[6] ,[28] "INSPQ deprivation Index"[7],[29,35] "area-based socio-economic status quintile index"[8],[49] and "CT/10"[9] [27] These various tools take into account information about income, education, access to services, community safety, and physical environment. These indices are not assessed at the individual level but are instead area-based indices at the neighbourhoods, communities or health care regions level. (Additional file 4 for details) More than half of the included studies (59%) analysed health care equity through this SEDH. (*It reflects abilities to reach and to pay*).

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[4] A composite score originates from the following domain indices: income, employment, health, education, access to services, community safety and physical environment

[5] An index of deprivation used in spatial epidemiology, based on four variables (Male unemployment, Lack of car ownership, Overcrowding and Low social class)

[6] A validated census- and geography-based index that measures marginalization at the level of the census dissemination area, including economic, ethno-racial, age-based and social marginalization

[7] Institut national de la santé publique du Québec (INSPQ) deprivation index: an index based on six socioeconomic indicators calculated at the dissemination area (DA) level. This index has two components, material and social. The material component is based on the proportion of people without a high school diploma, the employment-to-population ratio and the average income. The social component is based on the proportion of people living alone, the proportion of separated, divorced or widowed people and the proportion of lone-parent families

[8] Area-based SES quintile : an index of seven components based on American Community Survey (Education index, percent persons above 200% poverty line, percent persons with a blue collar job, percent persons employed, median rental, median value of owner-occupied housing unit and median household income)

[9] CT/10: a coefficient that refers to the effect of a 10% increase in the percentage of the population in the Census tract (CT) who have household incomes below 200% of the federal poverty threshold. (The poverty coefficient indicates the effect of a 10% increase in the fraction of the population living in poverty)

3.4.3 Income

To measure income differences, four studies that used this SEDH used median income household (divided into quartiles or thirds) [42,44,47,48] and one used presence versus absence of a reportable income.[51] (*It reflects the ability to reach and to pay*).

3.4.4 Education level

Depending on the studies, the education level was divided into three or four categories ranging from never attended school to graduate degree.[38,50] (Additional file 4 for details) (*It reflects the ability to perceive, to seek and to engage*).

3.4.5 Social class

This SDEH is defined hierarchically into six classes in descending order: professional, managerial, skilled non-manual, skilled manual, semi-skilled manual, non-skilled manual. This SEDH was used in one study to analyse health care equity.[32] (*It reflects the ability to reach and pay*).

3.4.6 Health literacy

In one study, health literacy was the SEDH used in the health equity-focused analysis, based on scores obtained through the Rapid Estimate of Adult Literacy in Medicine test, a reading recognition test comprised of 66 health-related words arranged in ascending order of difficulty.[33] (*It reflects the ability to perceive and engage*).

3.4.7 Financial and non-financial barriers

In one paper, these two types of barriers were used based on subjects' responses to 14 questions (7 questions each) relating to financial concerns[10] and non-financial barriers[11].[30] (*It reflects the ability to reach and to pay*).

3.5 Addressing health care equity through the association of emergency care indicators and SEDH

Across the studies, all identified SEDH were found to be associated with statistically significant differences in emergency care indicators. Descriptive examples of associations between equity indicators and some of the main SEDH identified in this review are presented below. The group of each indicator is highlighted in bold and in brackets. (See detailed data in Table S1 in Supplementary Materials)

3.5.1 Health insurance

In a large retrospective study including over 2.2 million patients, Lines et al. demonstrated that patients with public insurance are 2.5 times more likely to have preventable ED visits **(Group 1)** than private patients (Rate ratio 2.53, 95%CI 2.49-2.56).[34] Similarly, in another large retrospective cohort of 1.3 million patients, Metcalfe et al. highlighted a statistically significant association between in-hospital mortality **(Group 3)** and insurance status amongst patients presenting to hospital with acute surgical conditions requiring emergency surgery whereby uninsured patients were at significantly higher risk of death than privately insured patients (Odds Ratio 1.28, 95%CI 1.16-1.41).[43]

However, some studies do not show significant differences in access or quality of care based on insurance coverage.[39,42] Further, among the studies comparing patients

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[10] A set of seven self-reported financial concerns items: "insurance won't cover care", "the respondent will have to pay more than expected", "he/she will have to pay more than he/she can afford", "medications will cost too much", "not being sure about being dropped from the public healthcare program", "not knowing what the health plan covers and not knowing where to go with questions about coverage"

[11] Seven self-reported non-financial barriers including: transportation difficulties, problems making appointments, not knowing where go for care, work/family responsibilities, office/clinics not being open at suitable times, obtaining childcare and not being able to utilize one's preferred provider

with and without insurance coverage, two have shown an increase in ED use **(Group 1)** after introducing public insurance coverage for previously uninsured patients. For example, DeLeire et al. found an increase in total ED visits (Group 1) of 46% (p-value, p<0.01) and ACSCs ED visits **(Group 1)** of 38.7% (p-value, p<0.01) after the introduction of public insurance (Medicaid) among low-income childless adults.[25] Authors postulate that this may be due to insurance coverage increasing one's access to outpatient care, but also to ED-based care. Similarly, Kerr et al., who compared ED visits rate **(Group 1)** amongst a cohort of HIV-positive patients with varying health insurance coverage (n=4,947), showed that uninsured patients used the ED significantly less than privately insured patients (Incidence rate ratio (IRR) 0.65, 95%CI 0.61-0.70), but that patients with Medicaid (public insurance program in the US) used the ED more frequently (IRR 1.26, 95% CI 1.18-1.36).[27]

3.5.2 Social deprivation

Although many different area-level indices among studies measure social deprivation, it appears to be significantly associated with the three categories of emergency care indicators identified in this review. For example, Vanasse et al. show a relative risk of ED visits **(Group 1)** of 3.82 among women with mood disorders in Québec of the most deprived quintile compared to women of the least deprived quintile (based on an index combining social and material deprivation).[28] Then Lazzarino et al., who used the Carstairs Index, highlighted a significant difference in the likelihood of having a brain scan on the day of admission **(Group 2)** for patients presenting to the ED with an acute stroke between the least and the most deprived quartiles (Odds ratio 0.94, 95%CI 0.89-0.99).[37] Similarly, Thorne et al. demonstrate a significant association between 30-day mortality **(Group 4)** after ED admissions for hip fracture and social deprivation quintile with patients in the most deprived quintile at higher risk than those in the least deprived quintile, based on the Index of Multiple Deprivation (Odds ratio 1.19, 95%CI 1.15-1.23).[46]

3.5.3 Income

Findings regarding median household income were mixed across studies. Among the four studies using this SEDH, two demonstrated significant associations between median household income and emergency care indicators [44,48] and the other two did not.[42,47] (See Table S1 in Supplementary Materials)

3.5.4 Education level and Health Literacy

Contrary to expectations, only two studies assess this SEDH, including one with a small sample of patients (n=647), which found that lower education level was potentially associated with an increased risk of being an "emergency presenters" (defined as presenting to ED around the time of a new cancer diagnosis) **(Group 1)**.[50] The other study, by Stecksen et al., highlighted that access to reperfusion therapy (group 2) for stroke is associated with higher patient education level (Odds ratio 1.14, 95%CI 1.03-1.26).[38] Only one study analysed the impact of health literacy on potentially preventable ED visits and found that patients with low health literacy are approximately twice as likely to have preventable ED visits **(Group 1)** than patients with adequate health literacy, even after adjustment for relevant confounding factors (Rate Ratio 1.93, 95%CI 1.55-2.40).[33]

4. Discussion

Findings of this systematic review, which identified 14 health equity indicators and 7 SEDH, suggest that administrative data allows for a comprehensive analysis of health care equity in emergency care settings. Using these health equity indicators, each of which measures different aspects of the patient pathway through emergency care, combined with various SEDH described, presents a promising way to conduct health equity analyses of health care systems. Based on these findings, we have created a conceptual framework for assessing health care equity, combining SEDH through different categories of emergency care indicators, depicted in Figure 3.
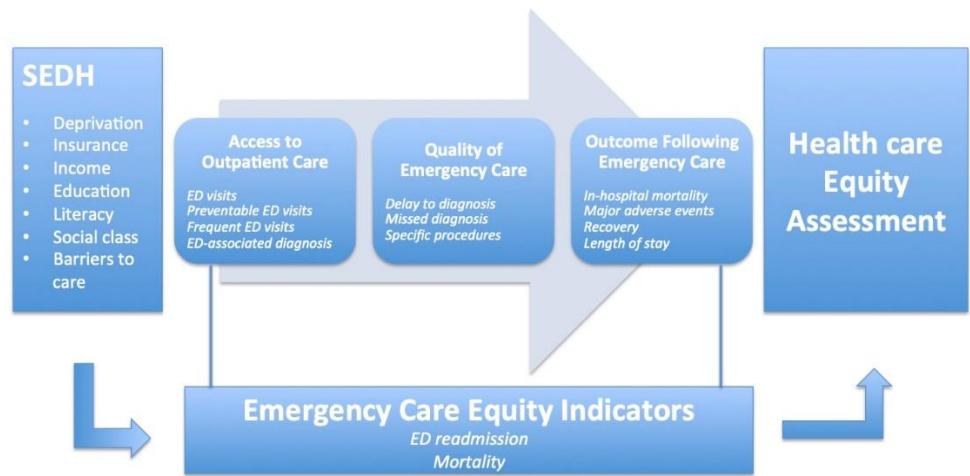
Figure 3. Conceptual model of Assessment of Health care Equity
Representation of a conceptual synthesis of the assessment of health care equity in an emergency setting, through the combination of socio-economic determinants of health with emergency care equity indicators.

4.1 Emergency care Equity indicators

The most frequently used indicator is ED visits/Emergency admissions. However, due to its lack of specificity, it must be interpreted with caution. There are notably many factors that could explain differences in ED visits or emergency admissions beyond health care equity, particularly differences in general health status and prevalence of diseases.[52] ACSC ED visits/ACSC emergency admissions are arguably more specific as it focuses on ED visits/admissions that are potentially preventable with good access to primary care.[16,53]

The indicators comprising Group 2 (indicators of quality of emergency care) directly analyse emergency care and are therefore more specific in their measurement of health care equity in emergency care settings than indicators in Group 1. We found that they are used considerably less. It may reflect the difficulty in obtaining relevant data to measure these indicators through administrative datasets. However, they might be useful indicators to use in future studies analysing health care equity.

Among outcome indicators (Group 3), in-hospital mortality seems to be the most reproducible and available administrative data-derived indicator.

Finally, 30/90/326-day mortality and ED readmission, which are more global equity indicators (Group 4) assess the lack of access to outpatient care following an ED visit and potential issues during the emergency care that lead to inequities in health outcome.

Due to the inherent difficulties of measuring a complex concept like health care equity and many potential confounding factors, using a combination of indicators instead of one sole indicator to measure health care equity in any given health care context is more likely to result in a well-rounded assessment. As such, we suggest combining indicators across the different groups when assessing health care equity. The choice of specific indicators will depend on the study's context, the study objectives and availability of administrative data (and relevant variables) in the health care setting of interest.

4.2 Socio-Economic Determinants of Health (SEDH)

Although median household income and education level appear to be standard and reproducible measurements, many studies chose to use specific area-level indices that account for the target population's multiple domains of deprivation. These indices combine different parameters to assess deprivation, such as income, employment status, living environment deprivation, and education. These indices are less reproducible than median household income since they require many more variables for their calculation (which may not be available in all health care administrative datasets). However, they are arguably better at measuring inequities due to the broad domains of deprivation they assess.

To assess the accessibility of health care services, one particular SEDH emerged: insurance status. Most of the studies analysing this SEDH were published in the US. We assume that this is due to the US healthcare system's specificities and the different health insurance reforms (most notably the Affordable Care Act),[54], making this a very relevant SEDH in the US context. Despite most of the studies being US-based, this SEDH seems relevant to most health care systems in high-income countries, even those with universal health care coverage, where some individuals can access private insurance that covers additional benefits, therefore creating potential inequities.[55] As such, this SEDH could be used more widely than currently represented in the literature.

4.3 Perspectives and implications

An important implication of our research is identifying four groups of indicators that can analyse equity in emergency care of high-income countries. As most of the indicators identified in this review are not specific to emergency care settings, it seems possible to study health care equity in other areas of the health care system of high-income countries with similar administrative data-derived indicators, as hospitalisation,[56,57] ACSCs during the total hospital admission,[58] and wait times.[53] Such information could be useful for policymakers or health equity researchers to fill the gap in data about health care equity within different health care settings, mainly in high-income countries, using available administrative data.

Our findings suggest that SEDH have a considerable impact on health care equity. The next step would also be to characterise better root causes for differences in emergency care utilisation that lie outside the health care system. For example, in a recent study, McCormick et al. demonstrate that emergency admissions are primarily due to a higher prevalence of illness in disadvantaged areas,[52] while Pollack et al. who analysed the relationship between neighbourhood poverty and ED use in a 21-year randomised social experiment did not find a consistently significant connection between neighbourhood poverty and ED use.[58] More studies like these are needed to improve our understanding of the complex interconnectedness between SEDH, health care use and health care equity.

4.4 Limitations

Our review has some limitations that require consideration. First, administrative datasets' content and quality are highly variable within countries (sometimes even within

regions) and between countries. As such, many of the indicators identified in our review might not be available in many health care settings, reducing their generalizability and widespread applicability. However, important equity indicators such as preventable ED visits are frequently used and easily replicable between countries. Secondly, administrative data are not designed for equity monitoring, which implies a lack of robust quality control of the collected data, a time lag in data availability, differences in concepts and definitions used between datasets limiting comparability, and the possibility of missing records. Further studies of health equity indicators and SEDH using different types of datasets would help the researchers address this. Third, to define the criteria relevant to this review, it was necessary to make many normative choices before data analysis. Our focus has been indeed solely on SEDH and their associated inequities. It would also be essential to analyse equity, in complementary studies, through determinants of health such as race/ethnicity, gender, or place of residence to have a comprehensive picture of health care equity. These results must be interpreted in the concept of health care equity and the definitions we used.

Lastly, as more than half of the studies were conducted in the US, the results' extrapolation should be carefully interpreted.

5. Conclusion

Measuring health care equity should be an integral component of all comprehensive assessments of a health care system's performance. However, to measure health care equity, indicators for making such measurements need to be identified, as was the goal of this review. Such indicators can be used by researchers and policymakers interested in measuring health care equity through thoughtful selection of the most relevant indicators defined by the local context and stated objectives. Using a combination of indicators is likely to lead to a more comprehensive, well-rounded analysis of health care equity than using any one indicator in isolation. Though studies analysed focused on emergency care settings, it seems possible to extrapolate these indicators to measure equity in other areas of the health care system. Meta-analyses focusing on specific socio-economic determinants of health such as health insurance coverage, income or indices of social deprivation in combination with studies analysing factors that could influence the use of emergency care related to social inequalities would help further characterise root causes of ongoing health care inequity in health care systems.

Supplementary Materials: The following are available online at www.mdpi.com/xxx/s1, Supplementary file S1: Research Protocol, Supplementary file S2: PRISMA-equity Checklist, Supplementary File S3: Full Search Strategy, Supplementary Table S1: Description of the selected studies, Supplementary Table S2: Risk of bias assessment

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