A Review of The Characteristics of Super-Utilizers and Evidence-Based Approaches to Reduce Healthcare Utilization

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A REVIEW OF THE CHARACTERISTICS OF SUPER-UTILIZERS AND EVIDENCE-BASED APPROACHES TO

REDUCE HEALTHCARE UTILIZATION

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Table of Contents

ABSTRACT

A significant fraction of health care resources in the United States of America is utilized by a comparatively small number of people. An examination of the attributes and patterns and associated evidence-based interventions for such high-utilizing patients might aid clinicians to improve interventions to address the distinctive needs of these patients, decrease their risks for numerous hospitalizations, and contribute to reducing the costs. This study aims at exploring the existing literature on the characteristics of super-utilizers and interventions to reduce avoidable use of health care among this population. The method used for this research is a comprehensive literature review. Search from various academic databases, such as Pubmed, SciFinder, Scopus, and CINAHL has been included. Grey literature was also included. This research is restricted to studies and evidence specific to the United States. Literature review results show that super-utilizers are more likely to be female, with lower income, low education status, and suffer from multiple chronic conditions like diabetes, heart diseases, etc. and/or mental health illnesses. Super-Utilization definitions vary by studies. Several studies that included pre-post evaluations showed significant declines in either health care use or cost or both. It is important to prioritize public policy and investment into the super-utilizer communities to ensure awareness, accessibility to socio-economic and political resources, to ensure their overall well-being and that we target evidence-based interventions aimed at such communities.

CHAPTER 1 – INTRODUCTION

As per common knowledge in the society, "super-utilizers" are those who visit the hospitals very frequently, which is the reason why they incur huge costs. To understand the geographic areas where super-utilizers are concentrated, efforts were put in the Camden region of New Jersey by using data-mining exercises (Sevak, 2018). The Super utilizer study was originated from the Camden area of New Jersey by Doctor Jeffery Brenner. He noticed that only a limited number of patients accounted for a majority of health care costs in this health system, and developed a program to address the physical, social, and mental health of these super-utilizers to prevent and manage their unnecessary health care use. However, it was difficult to categorize super-utilizers based on the geographic location, as people within the super-utilizer group are heterogenous (Rinehart, 2018).

The Rationale for the Review

Super-utilizers accumulate high healthcare costs. Given the fact that health care expenditures account for 18 percent of the United States Gross Domestic Product and, astonishingly, a large proportion of health care resources in the United States are consumed by a relatively small number of individuals (Johnson, 2015).

In the United States, many healthcare organizations are looking towards applying new forms of care delivery to tackle social needs. It is a novel approach to prevent frequent hospitalizations to decrease hospital expenses (Fleming, 2019). The research available is limited, and it is uncertain in this period because there is increased emphasis on programs to help super-utilizers. Super-utilizer interventions have outpaced the actual proof of the success of their programs and therefore, we needed thorough research to be done (Sevak, 2018).

Numerous studies have focused on examining super-utilizers or high costs patients; however, understanding the characteristics of these super-utilizers and evidence-based interventions is limited. A study that reviewing the literature to understand the features of the super-utilizers and effective interventions can help reduce costs, are imperative, and would benefit clinicians, researchers, and policymakers to design tailored interventions. Our research summarizes the criterion for super-utilizer patients and highlights the importance of the demographic and clinical characteristics of super-utilizers. This research can also help with future recommendations and directing our actions towards better treatment and cost containment of super-utilizers.

<u>Objectives</u>

The specific objectives are:

1. To summarize the definition of super-utilizers and to review and summarize characteristics of super-utilizers such as demographics, socioeconomic status, and presence of diseases.

2. To summarize evidence-based approaches targeting super-utilizers and report the effects on the reduction of healthcare utilization and associated expenditures.

CHAPTER 2 – BACKGROUND

<u>Description of the Health Problem</u>

The term "super-utilizers" does not have a commonly accepted definition in the USA. According to the Robert Wood Johnson Foundation, a "super-utilizer" is a person whose "complex physical, behavioral, and social needs are not well met through the current fragmented health care system" (Hasselman, 2013). The Centers for Medicare and Medicaid Services (CMS) has defined super-utilizers as "patients who accumulate large numbers of emergency department (ED) visits and hospital admissions which might have been prevented by relatively inexpensive early interventions and primary care" (Johnson, 2015). Agency for Healthcare Research and Quality (AHRQ) categorized super-utilizers as patients who had four or more hospital admissions (Jiang, 2015). They considered hospital stay as a unit of analysis, which indicates that if a person is repeatedly admitted into the hospital, each time is counted separately (Jiang, 2006).

Health care needs go unmet for super-utilizers. These super-utilizers are generally affected by many chronic diseases and, as a result, get repeatedly admitted into hospitals, especially the emergency department, thereby causing huge healthcare costs (Harris, 2106). An analysis of super-utilizers who are not insured within Medicaid populations revealed that such populations are disposed to having several chronic conditions. Also, a peculiar observation of substance abuse conditions within the super-utilizers of Medicaid populations was commonly seen when compared to Medicare populations. However, the history of the medical conditions of the patients is not enough to analyze the patterns of multiple hospitalizations. It was observed that super-utilizers are affected by many comorbidities,

which often display medical discrepancies too. Even after discharge, they suffered medication inconsistencies and drug therapy problems (Surbhi, 2016).

Growing evidence suggests that many of these super-utilizers do not get adequate coordinated care or preventive care (Lynch, 2016). It is vital to provide super-utilizers with essential support systems involving housing, food, insurance, etc. to stabilize their socioeconomic conditions (Fleming, 2019). Research indicates that medical and social complexity together aggravates healthcare use by super-utilizers. In the US, the needs of SDOH (Social Determinants of Health) account for nearly one-third of annual deaths. (Anderson,2016). There is insufficient literature surrounding the use of screening for and addressing SDOH needs. The Centers for Medicare and Medicaid Services, the National Academies of Sciences, Engineering, and Medicine, the American College of Physicians, and the American Academy of Pediatrics endorsed screening for SDOH in health care settings.

There is a critical need to think about super-utilizer patients with a viewpoint of health care reform (Uberoi, 2015). To allocate the resources for super-utilizers, reforms need to be well planned. It would require the engagement of stakeholders, supported by thorough data, well designed clinical studies, with appropriate policies surrounding the problem (Emeche, 2015). Efforts to reduce the costs of super-utilizers might indeed transform the US health care system (Emeche, 2015). Super-utilizers got the attention of policymakers (Fuller, 2017) who have given importance to policy initiatives intended at preventing the burden of healthcare costs on the system through various interventions at various levels of the community as well as primary care (Johnson, 2015).

Several targeted care transition programs assess the characteristics and patterns of hospitalization and health outcomes for super-utilizers with multiple chronic conditions (MCC) (Harris, 2016). Community-based organizations, accountable care organizations, accountable care communities, and health systems around the United States have also designed and implemented programs to address super-utilizers' needs of health care, including programs focusing on high users of emergency care (Iovan, 2019) and community-based care coordination programs along with primary care (Emeche, 2015). There is also evidence of high-intensity care management programs and providing care coordination through interdisciplinary mobile teams for people suffering from MCC, to reduce short-term service use and spending for Medicare super-utilizers (Sevak, 2018). There are also traditional approaches with the proliferation of team-based care models intended to address the requirements of super-utilizers in response to increased costs (Sevak, 2018). Integrated delivery systems (IDS) offer great opportunities to involve in the strategy of how to create good coordination of care across all the health care departments (Durfee, 2018). If we analyze it as a care model perspective, IDSs offer a coordinated service, thereby facilitating clinical integration through sharing culture and patient population. IDS data systems can fully obtain the continuum of care through shared electronic databases, allowing better delivery of health services (Durfee, 2018).

This study complements the super-utilizer literature by synthesizing research findings in terms of demographic, socioeconomic, and clinical characteristics of this population and summarizing the results of current evidence-based interventions for super-utilizers. This research can thus help with providing future recommendations to clinicians when treating super-utilizers and help the policymakers when making policies that benefit the super-utilizers. This literature review will also contribute to research on the effects of intervention

programs targeting super-utilizers on reducing healthcare utilization and costs. Early identification of patients at risk for super-utilization

may allow an opportunity for targeted management of their medical and social needs and reduce the potential use of health services.

CHAPTER 3 – METHODS

Search strategy

Multiple databases are searched, including Pubmed, SciFinder, Google Scholar, Scopus, and CINAHL, for eligible articles published between 2010 and 2019. We have included reviews, cohort-intervention studies, empirical data studies, and editorials. The online catalog at Mc Googan's Library at the University of Nebraska Medical Center (UNMC) has been utilized to search articles for this topic. The literature review efforts to gather the data were guided by librarian Terry Hartman at the UNMC using the University's Library System. We also searched in the Cochrane Database of Systematic Reviews to find review articles published previously. Besides, we searched reference lists of all relevant articles to ensure the completeness of our database search. Grey literature has also been reviewed that included issue briefs, reports from state and federal agencies, and a few other additional reports from nationally recognized organizations. Duplicate articles have been removed, and articles were selected based on our inclusion and exclusion criteria. Keywords used for research included: *Super-utilizers, emergency super-utilizer, high utilizers, frequent flier, non-urgent high utilizers, high-risk patients, high-cost patients, super utilizer programs, high utilizers, hot-spotters, high healthcare costs, Adult Super-utilizers, charges incurred by super-utilizers, expenditure, cost evaluation, characteristics of super-utilizers, super-utilizer intervention studies, super-users, super frequent users.*

<u>Inclusion and exclusion criteria</u>

Included articles are limited to studies conducted in the United States of America. This is done to make our review more relevant to the healthcare system here in the USA, as our research can help tackle the complexities here with the super-utilizers. We have included super-utilizers of ages 18 years and above in our study. Exclusion criteria involved studies that have taken place elsewhere other than the United States, theses, articles from magazines, and qualitative research. We have also excluded pediatric super-utilizers as there is not much literature available on the topic.

<u>Data extraction</u>

The subsequent attributes from studies were obtained: definitions, demographic and socioeconomic characteristics, health conditions, types of interventions, study design, disease condition, findings, costs accrued, descriptive data, and recommendations.

CHAPTER 4 – FINDINGS

A total of 158 articles were obtained through search engines as well as from the reference lists of the articles gathered. After applying inclusion and exclusion criteria and eliminating duplicates, of which 35 articles were found that did not involve pediatric super-utilizers and studies published in the US between 2010-2019. Of these 35 articles, 25 were related to the interventions on super-utilizers. Below are the findings.

<u>Findings on definitions/operationalization of super-utilizers</u>

There is no consistent definition of 'super-utilizers' across studies. There are 13 articles from the literature identified discussing the definition of super-utilizers. Several terms are used for "super-utilizers" like "Super-Frequent Users", "High -utilizers", "Hot-spotters", "Super-users" etc. (Table 1). And, there are many definitions for "super-utilizers." We have tried to summarize all of them in our review in Table 1. The super-utilizers or frequent users were defined mostly by the number of visits, ED visits, or inpatient admissions in various amounts of time (6 months to a year). In the studies that we included, definitions for super-utilizer varied from more than 2 visits in 6 months to more than 10 visits in a year. In this literature review, all studies with various definitions of super-utilizers were included.

Findings on characteristics of super-utilizers

An analysis of the characteristics of thirty-five (35) articles was conducted. Studies on super-utilizer interventions from 11 articles (31%) took place in the Eastern US. Two studies (6%) were from across the US. Six (17%) studies were from the Midwest. Another six (17%) studies took place in the South Eastern US. Seven (20%) studies took place in the Western US. Three (8.5%) studies did not specify the location (Table 2).

Findings on demographic characteristics of super-utilizers

Seventeen (50%) articles indicate that females were the majority in their studies. Ten articles (28%) showed that males are a majority of the super-utilizers. Eight articles (22%) did not specify the gender of the super-utilizer group. Sixteen articles (45%) stated that a majority were above 50 years of age and thirteen articles (37%) specified less than 50 years, whereas six (17%) articles did not specify the age. Seventeen (50%) articles did not specify the race whereas nine articles (25%) indicated that super-utilizers were 'Black' and seven articles (20%) specified super-utilizers were 'White'. Six articles (17%) showed that super-utilizers were homeless, and fifteen articles (42%) did not specify the insurance status. Six articles (17%) showed that super-utilizers were insured by 'Medicare'. Four articles (11%) indicated that super-utilizers in their studies were 'White'. Four articles (11%) indicated super-utilizers were unpartnered/unmarried (Table 2).

Findings on disease characteristics of the super-utilizers

In nineteen articles (54%), super-utilizers had multiple chronic conditions. Eight articles (22%) indicated substance abuse along with multiple chronic conditions (MCC) like heart disease, diabetes, depression, etc. as the main clinical conditions of super-utilizers.

14

Fifteen articles (43%) indicated that super-utilizers suffered from mental health problems which is a significantly higher proportion of super-utilizers. Three articles (9%) indicated that super-utilizers experienced trauma (Table.2).

Findings on socio-economic characteristics of the super-utilizers

These super-utilizers grapple with the socio-economic challenges of poverty and lack of employment; they experience food insecurity, unstable housing, and lack of transportation facilities; lack of insurance and awareness of health education; and are deprived of access to stable primary and supportive care. Two articles (6%) mentioned a lack of transportation. Three articles (9%) mentioned a lack of education/illiteracy. Nine articles (26%) mentioned unstable housing/homelessness. Seven articles (20%) mentioned poverty/low household income. Four articles (11%) mentioned lack of nutrition (Table 2). Due to these circumstances, super-utilizers get repeatedly admitted to emergency department and/or hospital inpatient unit, which contribute to the burden of higher healthcare costs (Table.2).

By analyzing all the above data, we can say that most super-utilizers were likely to be females, older, homeless, had low income, were likely to be insured by Medicare and suffered from MCC, substance abuse, and mental health illnesses. Trauma, lack of transportation, food insecurity, illiteracy, low income, being unpartnered were some of the characteristics of minority of super-utilizers.

Findings on interventions to reduce utilization

A total of 25 intervention studies to reduce health care utilization for the super-utilizers were searched. Of these studies, ten articles (40%) used simple pre-post analysis of the interventions. Three articles (8%) used quasi-experimental study designs. Three articles (8%) were cross-sectional observational studies (Table 2).

The main goals/objectives of the interventions were to reduce hospital utilization. Twenty-two articles (88%) showed significant avoidance of overutilization of healthcare resources and outcomes that benefit both the healthcare organizations as well as the population studied. Hospital readmission rates were calculated for 30-days and 90-days., while other articles investigated the overall decrease in hospital admissions throughout the year (Table 2). Declines in hospital admissions ranging from 7% to 52% were observed. Declines in ED visits ranging from 21% to 49% were seen (Table 2). A decline in inpatient admissions by 39% was observed (Grover, 2018). Only one article (4%) stated that there was no change in the 'Length of Stay' (LOS) for super-utilizer patients (Mercer, 2015). No other articles calculated length of stay in the hospitals for the patients enrolled in the intervention programs (Table 2). Fourteen articles (56%) showed decrease in hospital visits. Overall, we have observed a considerable decrease in the aggregate number of hospital admissions, which is likely due to an improvement in patient outcomes as a result of the interventions. Apart from interventions that looked into a decrease in hospital visits and decrease in cost outcomes, there was an article that focused on pharmacist-led intervention, that focused on identifying medication discrepancies in super-utilizer patients and the outcome of the study was that many drug discrepancies were identified and addressed in super-utilizer patients (Surbhi, 2016).

Identification of specific themes in the interventions from our review

The studies from 25 articles showed a plethora of interventions. We can identify some common themes in the interventions that were used for super-utilizers in our study. Interventions targeting super-utilizers within a community or interventions targeted at super-utilizers with specific disease condition or based on admission to hospital, etc.

Interventions targeting super-utilizers within a community

Few examples are 'Citywide Care Management System Program' that delivers care to super-utilizers in their homes, or even on the street (Green, 2010); Use of 'Community Navigators' to navigate clients to health and social resources in their community (Bailey-DeLeeuw, 2018); 'Inter-organizational collaborations' that take care of the specific communities in their state (Robert wood Johnson Foundation, 2010). 'CARES' (Community Assistance Referral and Education Services) is a community-wide collaboration program. CARES program assists patients in developing their health goals, and prevents the patients from making excess 9-1-1 calls, from being admitted to emergency room visits, etc. (Bronsky, 2017).

Interventions targeting super-utilizers affected by disease conditions

Different interventions were used for different target population like 'Diabetes self-management education' (DSME) program for diabetic super-utilizers, 'Care Management Program' for people affected with multiple chronic conditions, 'CCM' (Complex Care Management program) for super-utilizers with complex medical conditions, 'High-intensity care management program', etc. (Table 2).

Interventions targeting super-utilizers based on admission and coordination of care

PACT (Preventable Admissions Care Team) intervention targets inpatient translation care. 'Enhanced Care Program' (ECP) is a primary care intensive care program, and 'Outpatient Complex Case Management' (OPCM) is the program to manage the health of outpatient super-utilizers. 'ED case management program' specifically targets ED super-utilizers, and Intensive Interdisciplinary Transitional Care focuses on transition of care between different health care organizations and units.

Interventions targeting super-utilizers through software tools

Machine learning approaches and tools such as 'Health literacy tool' and 'Clinical decision support tools' integrated directly into provider workflow that is easy to serve as interventions while simultaneously, they can cut downtime and process costs (Table 2).

Interventions led by healthcare workers

Interventions led by healthcare workers involves team-based care to match specific primary care resources based on the need of super-utilizers. Few examples are: 'Pharmacist led intervention' for medication management, 'Bridge SU Model' which is a social worker-led transitional care intervention, and 'Quality-improvement intervention' (Table 2).

These innovative interventions described above also shed lights on the need for redesigning the interventions to suit specific type of super-utilizer population.

Findings on sub-group analysis of cost-related interventions

A subgroup analysis of the 16 articles out of 25 articles that included interventions was illustrated in the Table 2. These 16 articles included outcomes related to charges incurred and the costs avoided due to interventions. Eleven articles (69%) show that there is significant avoidance of costs due to the interventions on super-utilizers. A range of costs of $211,129 was averted for a sample of 19 patients. Three million dollars were averted for a sample of 446 patients and net charges of $26 million were averted for a sample of 2,048 super-utilizer patients (Table 2). Two articles (12%) display that there were no statistically significant changes in the avoidance

of costs after the post-analysis of the interventions (Table 2). Three articles (19%) signified how even a small proportion of the population could contribute to huge costs due to overutilization of services (Table 2).
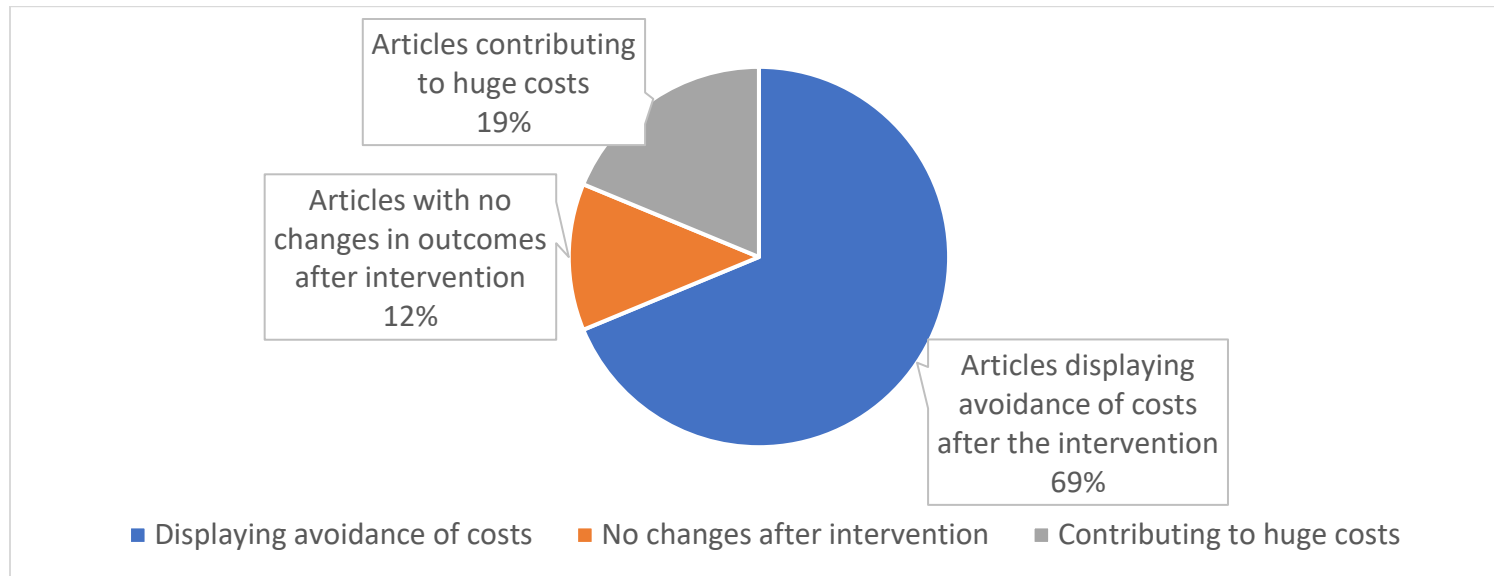

Figure 1. Pie chart displaying information we gathered from articles related to costs

CHAPTER 5 – DISCUSSION.

Summary of findings

Although the specific definition of super-utilizer varies among the studies, we can conclude that patients who use the healthcare system with greater frequency are super-utilizers. We have found in our review that super-utilizers are likely to be females, older, suffered from multiple chronic conditions, mental health illnesses, experienced homelessness, and had lower income. Some of super-utilizers had lower education and were less likely to be insured. We could not extract information on race as most of the articles did not have the information. Poor socio-economic conditions cause disproportionate burden on minorities and missing information on minorities is a huge drawback. Super-utilizers were affected by socio-economic conditions like lack of transportation, food insecurity, illiteracy, low income, lack of access to primary care, etc. Eighty eight percent of interventions on super-utilizer yielded positive results which means the evidence is intensifying that team-based care coordination, appropriate medical and behavioral health treatment, and planned transitions between facilities and providers can reduce costs associated with super-utilization and improve super-utilizers' health outcomes.

As there is no universal definition for "super-utilizers" it is very difficult to compare the results across various studies. The characteristics of the super-utilizers such as being older, unpartnered, lack of insurance, and affected with MCC, reflects the general perception of people towards super-utilizers. There are many gaps in the literature as we could not gather the complete characteristics of super-utilizers as the articles had insufficient information regarding many aspects of the characteristics of the super-utilizers. Most

articles did not specify the race of super-utilizers. We do not know how the healthcare delivery services are affecting the minorities. We do not know if the minorities who are super-utilizers are even identified as super-utilizers. Also, forty two percent of the articles did not mention insurance status which implies that there is a possibility of them contributing to a higher cost burden due to lack of insurance.

To identify the impact of interventions that are used to reduce the over-utilization within various health care settings, a greater quality of research is needed with more robust study designs. Most of the pre-and-post intervention studies did not have control groups leading to weaker designs. One of the studies had a sample size of nineteen (Hardin, 2017). It could be difficult to apply the same intervention to a larger sample. Better data collection, monitoring of the intervention, and better research design should take place for reliable outcomes. Articles focus either on ED department utilization or inpatient utilization. But we do not know the disparities in utilization between the departments within the same healthcare organization. Such discrepancies make it difficult to know the total number of super-utilizers within at least a single healthcare organization. Also, whether the discrepancies exist in super-utilizer studies across various health care settings throughout the US are unknown.

Even when it comes to costs, 65% of the articles did not measure the impact of interventions on indirect costs (e.g., time saved, individual visit costs that were avoided, travel cost saved, decrease in the length of stay in the hospitals, etc.). Focusing on super-utilizers positions us to help patients who often are not getting the kind of care they need while creating the greatest short-term return on investment with cost savings to the system. A majority of the articles (69%) displayed cost avoidance. The cost -analysis from this review gives us hope that when certain interventions are used, they can significantly reduce the costs of saving money for the healthcare system as well as the patients.

Managerial/Policy implications

Health care systems and insurance companies are constantly looking for ways to improve care and decrease the use of the most expensive health care services. This review may help health policy officials, public health officials, and organizations related to healthcare make informed decisions on how to interact with this specific population. The health policy relevant to the super-utilizer population is policies regarding reduced repeated hospitalization, which is avoidable. The Hospital Readmissions Reduction Program (HRRP) is a Medicare value-based purchasing program that reduces payments to hospitals with excess readmissions. Measures must be taken at the state level to advocate for reform. Affordable Care Act is encouraging to scale Super-utilizer strategy through State Innovation Model grants.

We may need to focus on the study with interventions targeting the high utilizer population. Although there is much focus on super-utilizers, there is still a dearth of evidence behind these endeavors. Low engagement rates were observed across a few studies. We recommend employing additional qualitative and quantitative studies to comprehend why some individuals do not engage in super-utilizer interventions when offered. We also recommend researching strategies for boosting better engagement rates. As this a vulnerable group of the population, there are also follow-up issues. The super-utilizers enrolled in the study may also die during the study period and are lost to follow up.

Several innovative interventions, such as 'Community-based care coordination', 'team-based care' etc. connects super-utilizers with primary care and community resources. Care coordinators (licensed practical nurse, medical assistant, or social worker) work with

super-utilizers to abate social determinants that contribute to high utilization and expenditures (i.e., lack of transportation, lower education, housing insecurity). Such interventions are a steppingstone for clinically redesigned interventions.

As super-utilizers are affected by substance abuse, homelessness, mental health issues, or lack of health knowledge, it is very difficult to implement one type of intervention as one size does not fit all. Several interventions were mainly cost-containment strategies directed at very expensive patients. More interventions would be needed to impact the macro-and community-level systems and institutions that drive social, political, and economic disadvantage and health inequities.

Establishing clear goals and constraints for a targeted super-utilizer population and sketching the needed outcomes of a program are necessary for accurately addressing the needs of the super-utilizers. It is very important to include healthcare professionals in studies and policies related to super-utilizers. Healthcare providers usually know the issues that super-utilizers face. Without considering their viewpoints, the government agencies may not be completely capable of identifying the issues, and as a result, the program that they implement may not yield fruitful results. The success of these interventions will further guide the policymaking.

Study limitations and suggestions for future research

This comprehensive review has several limitations. Many studies have used different terms for super-utilizers. They have used similar terms like super-users, super frequent users, etc. Although we have tried to gather all the relevant literature related to super-utilizers, as some studies use different terms to address this type of population, it is quite possible that we might have missed some

literature. We have also included studies that examined subgroups of super-utilizers (e.g., Diabetic super-utilizers or pregnant super-utilizers) along with the general super-utilizer population. As the results of these subgroups of super-utilizers are based on medical diagnosis, those interventions may not be applied to all types of super-utilizer population. This also could limit the generalizability of the study findings. The replicability of the intervention studies is also highly questionable as the studies were on the specified population of super-utilizers, and the approach to interventions differed. Although the literature helps to determine what programs are effective when targeting high-risk patients, we were unable to estimate high-risk patients accurately.

<u>Conclusions</u>

We started this research to identify the characteristics of super-utilizers and find evidence-based interventions and cost-analysis so that our findings may help policymakers and others researching super-utilizers. Although we could not gather every detail of the characteristics of super-utilizers, we learned that super utilizers are likely to be females, older, suffered from multiple chronic conditions, mental health illnesses, experienced homelessness, and had lower income. In addition, this literature review found that although current evidence-based interventions targeting for super utilizers have the potential to reduce the rate of hospital admissions and decrease the utilization of healthcare resources, more intervention studies are needed with more robust study design and larger sample size.

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Table 1. Definitions of Super-utilizers used in the Literature

Terms Used	Definition	Sources
Super-Utilizers	3 or 4 admissions in 12 months	Johnson, et al., 2015 Rinehart, et al., 2018
	≥2 hospital admissions in the past 6 months	Sevak, et al., 2015 Johnson, 2018 Bryk, et al., 2018 Lynch, et al., 2016
	≥4 ED (Emergency Department) visits of any kind	Kim, 2016 Houssanst, et al., 2017
Super-Frequent Users	>10 visits/year	Martin Ruggles, 2017
Frequent Users	4-10 visits in 1 year	Martin Ruggles, 2017
High-Utilizers	patients with ≥4 visits in the 6 months	Gingold, 2017
	≥10 ED visits in 6 months	Flowers, 2019
Hot-Spotters	≥4 hospitalizations or ED visits during the study period	Lee, et al., 2017

TABLE 2: Demographic, socioeconomic characteristics of super-utilizers and outcomes of interventions from the literature review

Source	Location	Super-utilizer inclusion & exclusion criteria	Characteristics of Super-utilizers	Sample size	Study design	Intervention Program	Healthcare utilization/cost outcomes	Article used for identifying characteristics/interventions/both
Green, 2010	Camden, New Jersey	N/A	Low income, mental health issues, substance abuse, MCC, homeless	N=36	Pre-Post analysis	CCMS Program (Citywide Care Management System Program)	36 super users incurred an average of $1.2 million in hospital charges each month. Significant decrease in the utilization of ED and hospital services, as well as improvements in patient outcomes.	Used to identify characteristics and intervention outcomes
Robert wood Johnson Foundation, 2010	South Central Pennsylvania	N/A	41% of Medicaid	N=446	Pre-post Analysis	Inter-organizational collaboration	Declines of 52% in hospital admissions, and 21% ED visits. It also averted costs of approximately $3 million insurance companies	Used to identify characteristics and intervention outcomes
Neighbors, 2013	New York	N/A	Majority male, mean age 34, mental health problems, substance abuse, MCC	N=1760	Pre-post Analysis	CM Program (Chronic Management)	These clients accounted for 49% of AODTx (High utilizers of alcohol and other drug treatment (AODTx) costs funded by Medicaid even though they were 12% of the AOD population	Used to identify characteristics and intervention outcomes
Jiang, et al., 2015	N/A	N/A	Majority 65yrs, Medicare, Female, Chronic conditions	N/A	N/A	N/A	Characteristics of super-utilizers were identified	Used to identify characteristics of super-utilizers
Johnson, et al., 2015	Denver, Colorado	Patients with or without insurance and with ≥3 hospitalizations in 12 months or had both a serious mental health diagnosis and ≥2 hospitalizations in the same period	70% MCC, 55% black or Hispanic, 40% Medicaid, 35% homeless, Individuals with serious mental health diagnoses, Trauma patients, Terminal cancer patients, Recipients of emergency inpatient dialysis. Orthopedic surgerypatients	N=4774	Cross-sectional and longitudinal analyses of Data from data-warehouse of Denver	6 types for 6 identified subgroups	When compared to the previous year, almost all subgroups showed a reduction in expenditures	Used to identify characteristics and intervention outcomes

LeBreton, 2015	Lancaster County, Pennsylvania	N/A	Male gender, > 65 years of age, unstable living situations, lack of transportation, lack of nutrition due to the inability to acquire food stamps	N/A	Pre-post Analysis	Method of teach-back education (health literacy tool)	Decreased over-utilization of health services.	Used to identify characteristics and intervention outcomes
Mercer, 2015	Durham, North Carolina	3 ED visits in 6 months with medical, social, or behavioral complexity.	Younger age, majority female, majority Medicare, presence of comorbidities	N=24	Retrospective pre/post-intervention analysis	Quality-improvement intervention	Hospital admissions and 30-day readmissions decreased after care-plan implementation ED visits, ED costs, and inpatient LOS did not change much. Inpatient variable direct costs decreased.	Used to identify characteristics and intervention outcomes
Kim, & Charlesworth, 2016	Oregon	N/A	Mental health conditions, younger age, female sex, poor physical health, and a history of primary care use. Dual insurance, >60 years, Black	N/A	N/A	N/A	The characteristics of super-utilizers were summarized	Used to identify characteristics of super-utilizers
Graven, et al., 2016	Oregon	N/A	Mental health, Males, dual insurance, older, commercial insurance, MCC, comorbidities	N=1002085	A retrospective longitudinal analysis of claims data	N/A	The patients were identified by payor types	Used to identify characteristics of super-utilizers
Lynch, et al., 2016	East Harlem, New York City	Patients with ≥3 chronic illnesses, psychosocial complexities and ≥2 hospitalizations in 6 months, ≥3 ED visits in 6 months, or ≥2 ED visits in 30 days	Majority- female, black, dual insurance, MCC, unstable housing, low literacy, unpartnered	N=171	Pre-post Analysis	PACT intervention (Inpatient transitional care program)	Average hospitalizations fell from 2.4 to 1.1 And emergency visit rates fell from 1.6 to 1.2, and the average number of hospital admissions decreased from 3.5 to 1.9	Used to identify characteristics and intervention outcomes
Surbhi, et al., 2016	Memphis, Tennessee	Adults aged ≥18 years with Medicare/Medicaid, ≥2 hospital admissions in 6 months or 1 inpatient admission and ≥2 ED visits in the past 6 months, diagnosis for ≥2 chronic conditions, or the presence of a high-	Multiple chronic conditions and polypharmacy Medicare, Medicaid, or dual-eligible patients, aged 18 years or older from medically underserved presence of high-risk medication.	N=374	Retrospective analysis of the Pharmacist-led interventions	pharmacist-led interventions	Detected cost evading of $293.30 per drug therapy problem	Used to identify characteristics and intervention outcomes

		risk medication were included Patients with cancer/psychosis/ pregnancy/surgery/ homeless were excluded						
Harris, et al., 2016	Memphis, Tennessee	Insured adults with MCC, and multiple hospitalizations & (ED) visits in a 6-months were included. Patients with cancer, pregnancy-related diagnosis, or a surgical procedure were excluded	Mean age 60.3, majority females, unmarried, African American, Medicare, MCC	N=1537	Retrospecti ve cohort study	SafeMed Program (Medication Management program)	This final study cohort (n = 638) experienced a mean of 3.2 hospitalizations and 2.8 ED visits without hospitalization in the 12-month follow-up period.	Used to identify characteristics of super-utilizers
Lim, 2016	N/A	>18 years of age with at least 2 hospital admissions in 6 months were included. Pregnancy/cancer/ high utilization from a single Catastrophic event/serious mental health diagnosis patients were excluded	Older, majority of females, majorly cardiac health failure super-utilizers	N=21	Pre-post Analysis	Pharmacist interventions	Overall, 144 pharmacist interventions transpired, and 98 medication discrepancies were found and addressed.	Used to identify characteristics and intervention outcomes
Hardin, 2017	Michigan	N/A	The population served had a prevalence of psychiatric diagnoses (100%), substance use disorder (53%), history of suicidality (42%), and complex social determinants of health issues, including history of trauma (58%) and current homelessness (16%). Surprisingly, the population was primarily less than 50 years old (68%).	N=19	Pre-post Analysis	Inter-organizational collaboration	Gross charges decreased by $721,654 in the 12 months after the intervention. Similarly, direct expenses decreased by $211,129	Used to identify characteristics and intervention outcomes

Gingold, 2017	Cheverly, Maryland	Individuals with ≥4 visits in the past 6 months	Majority male, median age 40-45 years, black, private insurance	N/A	A retrospective cross-sectional study in adult patients	Affordable Care Act	During the study period, 726 out of 17,795 unique patients in 2013 and 380 of 16,458 during the same period in 2014 were high utilizers	Used to identify characteristics and intervention outcomes
Bronsky, 2017	Colorado Springs, Colorado	Adults with a failure of medication or treatment. behavioral health problems; multiple 9-1-1 responses months were included. Adults outside of the study period or lacked data were excluded.	Majority Age 35-49, female, Caucasian, Medicaid insurance	N=441	Retrospective observational analysis of the CARES program.	Community-wide collaboration program called CARES	The median rate of monthly ED visits, 911 phone calls, and hospital admissions reduced significantly	Used to identify characteristics and intervention outcomes
Bookman, 2017	N/A	N/A	Majority female 55%, age 39, Medicaid, White, non-Hispanic	N=235,858	Longitudinal analysis	Clinical decision support tools integrated directly into provider workflow	A decrease in the ordering of 6,106 CT scan for 3 studies was observed.	Used to identify characteristics and intervention outcomes
Burton, 2017	Camden, New Jersey	Diabetic patients. Nonresidents, or younger than age 18 years, with type 1 diabetes or, lacking data were excluded.	Diabetic patients	N=123		Diabetes self-management education (DSME) program	No significant changes in the costs or the number of hospitalizations after the implementation of the DSME program	
Szymkowiak, 2017	Across the US	Homeless veterans between July 1, 2014, and December 31, 2015.	Older and disproportionately male, non-Hispanic white, and unmarried, with lower rates of post-9/11 service and higher rates of rural residence and service-connected disabled veterans.	N= 16,912	latent class analysis of secondary data	N/A	Medical, mental health, and substance use morbidity rates were high.	Used to identify characteristics of super-utilizers

			Homeless with more medical, mental health, and substance abuse, MCC					
Bryk, et al., 2018	Pittsburg	Individuals with ≥2 inpatient admissions and/or ≥6 ED visits over the last year	Majority age between 40-64 years, female, African American, Medicaid, MCC, mental illness	N=194	Pre–post-analysis of data before and after the intervention	Enhanced Care Program (ECP), a primary care intensive care program.	Showed considerable improvements in quality metrics.	Used to identify characteristics and intervention outcomes
Hay, et al., 2018	Pittsburgh	N/A	Mean age 64, cancer patients	N/A	N/A	N/A	N/A	Used to identify characteristics of super-utilizers
Rinehart, 2018	N/A	N/A	Alcohol disorder, homelessness, drug use, mental health, MCC, older, male, private insurance	N/A	N/A	latent class analysis	N/A	Used to identify characteristics of super-utilizers
Dastidar, & Jiang, 2018	Midwest		The population was 50.7% female and 49.3% male, with a mean age of 54 years, 77% were white and 20% were black. 45% were married. All but 1 patient was insured; 43% were commercially insured, 44% had Medicare, 12% had Medicaid only., substance abuse, narcotic drugs, Chronic disease, comorbidity, 77% white, unmarried, Medicare, mental health disorders	N=153	Pre-post analysis	N/A	N/A	Used to identify characteristics of super-utilizers
DuBard, et al., 2018	North Carolina	A clinical algorithm was used to identify Super-utilizers	Younger, female, White, MCC, mental health, substance abuse, lack of transportation, unstable housing, trauma, abuse, illiteracy, lack of nutrition	N=23455	Retrospective analysis of cost savings	CCM (Complex Care Management program)	2- to 3-fold greater return on investment.	Used to identify characteristics and intervention outcomes

Sevak, 2018	San Diego, California, Aurora, Colorado, Kansas City, Missouri, Allentown, Pennsylvania	≥2 hospital admissions were included Patients with cancer or serious behavioral issues were excluded	Individuals with multiple chronic conditions younger and more likely to live in high-poverty areas, Medicare	N=1068	Matched comparison	High-intensity care management program	Center for State Health Policy (CSHP) program reduced service use and expenditures in totality	Used to identify characteristics and intervention outcomes
Bailey-DeLeeuw, 2018	Memphis, Tennessee,	≥11 hospital visits stemming from ED during a predetermined 1-year screening period and be an inhabitant of the 38109-zip code.	Male, median age 41-45, Black, low literacy, low household income, uninsured, unemployed,	Intervention group N=159 Control Group N=280	Controlled pre-post design	Use of Community Navigators	13% reduction in hospital visits	Used to identify characteristics and intervention outcomes
Durfee, 2018	Colorado	Adult admitted patients with at least 2 other admissions or 1 admission + mental health diagnosis	Majority male, Medicare, Hispanic, ages 36-50 years, homeless	Intervention group N=2048 Control Group N=2147	Quasi-experimental approach	Practice transformation intervention	Charges for the intervention group were noticeably lower Net charges of nearly $26 million were avoided.	Used to identify characteristics and intervention outcomes
Price-Haywood, 2018	New Orleans, LA	Having Medicare insurance and 2 hospital/ED visits within 180 days of the index date	Older >75 yrs., female, majority low income, majority white, Medicare, MCC	N=18882	Retrospective case-control study	Outpatient complex case management. OPCM	90-day hospital readmissions were less in High-risk OPCM cases than the control group	Used to identify characteristics and intervention outcomes
Grover, 2018	N/A	≥10 ED visits in 12 months or ≥6 ED visits in 6 months or ≥4 ED visits in 1 month.	Majority female with majority Medicaid insurance, mean age= 42.4 years needing pain management; complex medical conditions; psychiatric illness; substance abuse; and needing resources	N=158	Retrospective chart review of ED and inpatient visits	ED case management program	ED visits fell by 49%, inpatient admissions fell by 39%, the use of computed tomography imaging fell by 41%, the use of ultrasound imaging fell by 52%, and the use of radiographs fell by 38%	Used to identify characteristics and intervention outcomes
Xiang, 2019	Chicago	Patients ≥18 years with ≥5 hospital admissions in a year	Average 65 years of age, female (56.5%) and African Americans (52.7%), average of 9 Elixhauser chronic conditions 37.5% of the study	N= 586	Retrospective evaluation of the intervention	Bridge SU Model (social worker-led transitional care intervention)	Considerable decrease in the aggregate number of hospital admissions, mean hospital costs per episode, and total hospital charges following the intervention.	Used to identify characteristics and intervention outcomes

			the sample had a diagnosis of depression and 15.2% had a diagnosis of alcohol or drug abuse disorder					
Connors, et al., 2019	Memphis	N/A	Mean age 57years, 60.7% female, 75% black, 40% Dual insurance, MCC	N/A	Pre-post analysis	N/A	Characteristics of super-utilizers were identified	Used to identify characteristics of super-utilizers
Krause, et, al, 2019	N/A	N/A	Men (71%) and white (60%), the average age was 49 at the time of the self-report assessment, MCC	N/A	Pre-post Analysis	N/A	Characteristics of super-utilizers were identified	Used to identify characteristics of super-utilizers
Turbow, 2019	Southeastern US	Geriatric patients	*65 years*	N= 57	Quasi-experimental study design	Pharmacist-led intervention	There were no statistically major differences in the figures for admissions	Used to identify characteristics and intervention outcomes
Bailey, 2019	Memphis, Tennessee	Age > 18 years with Medicare, Medicaid, or dual eligibility. medically underserved areas;	Majority female, older, black, comorbidities present	Intervention group N=285 Control group N= 1950	Quasi-experimental study.	Intensive Interdisciplinary Transitional Care	7% fewer hospitalizations 31% fewer 30-day readmissions along with reduced medical expenditures.	Used to identify characteristics and intervention outcomes
Hyer, 2019	N/A	≥65 years with surgeries Patients were excluded when they were not registered in Medicare parts A and B or visit, or recorded no visit within a year after surgery.	Majority 70-75, white, male, underwent surgery, with comorbidity,	N=1,049, 160	A retrospective cohort study	A machine learning approach to identify super-utilizers	Super-utilizers encompassed 4.8% of the cohort (n = 79 746) but, suffered 31.7%of the charges.	Used to identify characteristics and intervention outcomes

APPENDIX

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