Management of acute heart failure (diuretics, oxygen, afterload reduction, medication optimization)

Authors: Pickersgill S, Watkins D, Coates MM, Ahmed S, Kaur G, Hirpesa GM, Økland JM, Haaland ØA, Johansson KA

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Description of condition and intervention

Acute heart failure (AHF) is a condition that inability of heart to pump or flowing of blood to heart or brain. The three types of AHF are congestive (diastolic or systolic), left and right sided heart failure. The common symptom of this disease is discomfort in the centre of chest or unable to breath, arms, left shoulder, elbows, jaw, and back pain. This cause will increase with ageing, and the mortality, morbidity of this problem is also still high. The risk factors of this problems are unhealthy diet, physical inactivity, smoking, blood pressure, blood glucose, obesity, and alcohol. From an estimated death of cardiovascular diseases (CVD) 17.9 million, which represents 32% of all global deaths. Out of these deaths heart failure and stroke is responsible for 85% ((WHO), 2021). AHF can be treated by diuretics, oxygen, and vasodilators. The diuretics and oxygen first-line therapies for patients with AHF. Oxygen was used with diuretics and vasodilators. Vasodilators with diuretics are the most common drugs in emergency departments to treat AHF.

In this evidence brief, we present the effect and cost of the following intervention being analysed in FairChoices:DCP Analytical tool:

> *Management of acute heart failure (diuretics, oxygen, afterload reduction, medication optimization)*

International guidelines

Organization	Indications/recommendations
KSHF, 2019	Guidelines for the management of acute heart failure

Intervention attributes

Type of interventions

Curative

Delivery platform

This intervention may be delivered at referral and speciality hospital.

Equity

In addition to considerations like cost-effectiveness and health systems factors, dimensions of equity can be relevant for priority setting. The opportunity for a long and healthy life varies according to the severity of a health condition that individuals might have, so there are inequities in individuals' opportunities for long and healthy lives based on the health conditions they face. Metrics used to estimate the severity of illness at an individual level can be used to help prioritize those with less opportunity for lifetime health. FairChoices: DCP Analytics Tool uses Health adjusted age of death (HAAD), which is a metric that estimates the number of years lived from birth to death, discounting years lived with disability. A high HAAD thus represents a disease less severe in terms of lifetime health loss, while a low HAAD represents a disease that is severe on average, causing early death or a long period of severe disability. It is also possible to estimate the distribution of HAAD across individuals with a health condition. FairChoices shows for each intervention an average HAAD value of the conditions that are affected by respective interventions that have health effects. Additionally, a plot shows HAAD values for around 290 conditions (Johansson KA et al 2020). All incident cases irrespective of gender, income group are eligible to receive the intervention.

Time dependence

High level of urgency. Treatment outcomes may be highly affected by some hours of delay.

Population in need of interventions

Treated population:

The population in need consists of individuals aged 0 to 99 years. However, disease conditions that could lead to heart failure were assumed with following parameters for estimating the population in need of management of acute heart failure:

Ischaemic heart disease (IHD): 50% prevalence of heart failure due to ischemic heart disease for those age 30-95+

Hypertensive heart disease (HHD): 50% prevalence of hypertensive heart disease for those age 30-95+

Myocarditis: 50% prevalence of heart failure due to myocarditis in those age 0-95+

Alcoholic cardiomyopathy: 50% prevalence of alcoholic cardiomyopathy for those age 15-95+

Other cardiomyopathy: 50% prevalence of other cardiomyopathy for those age 0-95+

For all etiologies of HF, we assume that acute HF occurs at a rate of 0.50 per patient-year based on a study of incidence rates of HF in Olmsted County,Minnesota.

The affected population fraction is assumed 25% of IHD deaths are attributable to heart failure, (based on rates in England from 1981-1983).

(Source: NCD Countdown appendix)

Disease state addressed

IHD

HHD

Myocarditis

Alcoholic cardiomyopathy

Other Cardiomyopathy

Intervention effect and safety

Table 1: Effect and safety of treatment of acute heart failure

Effect of intervention		Certainty of evidence
Mortality (due to condition)	Effect on mortality was based on a systematic review of diuretics for heart failure: In the reviewed trials, mortality was lower for participants treated with diuretics than for placebo [3/111 (2.7%) deaths versus 12/110 (10.9%)], odds ratio 0.24;95% CI 0.07 to 0.83; P = 0.02. These trials assessed the effect of chronic diuretic therapy on HF mortality. There is limited evidence for the mortality benefits of diuretics in acute HF; however, trials suggesting no benefit have typically been done in HIC settings where other guideline-based therapies (e.g., ACEi, beta blockers) are already being used. These data points arguably represent false negatives in a LIC/MIC context where management of acute HF (ie, stabilization to euvolemia) is a critical first step in diagnosing HF and getting patients onto guideline-based chronic therapies that have a clear mortality benefit. Further, emerging evidence has found a mortality benefit from giving diuretics earlier rather than later in an acute hospitalization, suggesting that the lack of effectiveness in earlier studies may be a result of improper (eg, too late) administration. We therefore take the effect size of chronic diuretic use as a proxy for the effectiveness of diuretics (vs. doing nothing) on mortality from acute HF. ○ Converting from and odds ratio to a relative risk we get:43 RR = 0.24/([1-(12/110)]+[(12/110)*0.24]) = 0.262 The relative risk reductions for the following disease targets are: IHD: 73.8% * 25% = 18.5% HHD: 73.8% Myocarditis: 73.8% Alcoholic cardiomyopathy: 73.8% Other cardiomyopathy: 73.8% (Source: NCD Countdown appendix)	See appendix

Model assumptions

Table 2: Summary of model parameters and values in FairChoices – DCP Analytical Tool

Category	Model parameter	Notes
Intervention	Management of acute heart failure (HF)	
Cost parameters		
Treated population (GBD Study 2019)		
Gender	Both male & female	
Age	0-99 years	
Treated fraction	See population in need section for details	
Effect parameters		
Affected population		
Affected gender	Both male & female	
Affected fraction age	0 to 99 years	
Affected fraction	See population in need section for details	
Comparator	No intervention	
Mortality reduction (RRR) IHD HHD Myocarditis Alcoholic cardiomyopathy Other cardiomyopathy	 0.19 0.74 0.74 0.74 0.74	See table 1

Intervention cost

Unit cost of USD 4,033.62 is based on in-hospital heart failure patients costs in Brazil (Araujo et al 2005).

References

Johansson KA et al 2020: Johansson KA, Coates MM, Økland JM, Tsuchiya A, Bukhman G, Norheim OF, Haaland Ø. Health by disease categories. Distributional Cost-Effectiveness Analysis: Quantifying Health Equity Impacts and Trade-Offs. 2020 Sep 30:105.

Gerber et al 2015: Gerber, Y., Weston, S. A., Redfield, M. M., Chamberlain, A. M., Manemann, S. M., Jiang, R., Killian, J. M., & Roger, V. L. (2015). A Contemporary Appraisal of the Heart Failure Epidemic in Olmsted County, Minnesota, 2000 to 2010. JAMA Internal Medicine, 175(6), 996. https://doi.org/10.1001/jamainternmed.2015.0924

NCD Countdown appendix

Araujo et al 2005: Araujo, D. V., Tavares, L. R., Veríssimo, R., Ferraz, M. B., & Mesquita, E. T. (2005). Custo da insuficiência cardíaca no Sistema Único de Saúde. Arquivos Brasileiros de Cardiologia, 84(5). https://doi.org/10.1590/S0066-782X2005000500013.

Lee, J. H., Kim, M. S., Yoo, B. S., Park, S. J., Park, J. J., Shin, M. S., Youn, J. C., Lee, S. E., Jang, S. Y., Choi, S., Cho, H. J., Kang, S. M., & Choi, D. J. (2019). KSHF Guidelines for the Management of Acute Heart Failure: Part II. Treatment of Acute Heart Failure. Korean circulation journal, 49(1), 22–45. https://doi.org/10.4070/kcj.2018.0349.

WHO, 2021: Available from: https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)?

Appendix

Literature Review for effectiveness & safety

This literature search is an example of Level 1 search for intervention inputs taken from DCP3 or generated in an ad hoc manner (e.g., quick google search found one study of cervical cancer screening cost-effectiveness that was used to create an effectiveness parameter for that intervention).

Level of evidence of efficacy studies:

1. low (expert opinions, case series, reports, low-quality case control studies)
2. moderate (high quality case control studies, low quality cohort studies)
3. high (high quality cohort studies, individual RCTs)
4. very high (multiple RCTs, meta-analysis, systematic review, clinical practice guidelines)