SDC Table 1: Studies Included in ICD Population

Study	Design/Sample	Intervention	Outcomes	Results	Summary/Conclusions
Fitchet et al (2003)[33]	**Design:** RCT-crossover trial. (n=16) **Sample:** Time since ICD implantation 20.4±13.8 mo **Device n (%)** Single-chamber ICD 16(100%) **Gender:** n(%): Male: 14 (88%) **Age** 58±10y; range 34±74y **Ethnicity:** NR **ICD Indication Secondary** 100% **LVEF%** 38±17 **Dropout rate:** Group 1: 50% Group 2: 12.5%	**EX:** CR with tailored aerobic exercise (1.5 hr/2x/wk at 60-75% of HR) x 12 wk - Education/ cognitive behavioral intervention (30 min weekly) - Supplementary exercise at home/ community - Support was combination of positive feedback to exercise + psychological support/interventi on n=8 **C:** 12 wk usual care n=8 **Both groups**: 24- hour ICD advice line	**12 wk post- program:** **Exercise capacity** Exercise time (min) **Adverse events** ICD shock:(frequency of events, n of patients) - During exercise - During the study period - During 12 wks before program (control period) **Arrhythmias and safety** Sustained ventricular tachycardia (number of events) terminated by anti-tachycardia pacing (ATP) - During the program - During 12 wk before program (control period) NSVT not requiring ICD treatment; events (n) & patients (n): - During the program - During the 12 wks before the program (control period)	**12 wk post- program:** **Exercise capacity** Exercise time **EX:** 11:11±2:17 **C:** 9:54±3:14 P=NR **Adverse events** ICD shocks - During exercise: 0 - During the study period: 2 (in 2 pts) - During 12 wk before program (control period): 0 **Arrhythmias and safety** SVT terminated by ATP - During the program: 3 (in 2 pts) - During 12 wk before program(control period): 2 (in 2 pts) NSVT not requiring ICD treatment - During the program:	**Level of Evidence**: II **Jadad score =** 2 **Strengths** - 2 initial baseline CPET - Encouraged spouse attendance (50%) - Telemetry wrist monitor (facilitate feedback and aid compliance) **Limitations** - Small sample size - No comparisons between exercise and control groups were made. - Complete data not available for all patients in the 12 wk after completing the CR program. - Higher dropout rates in those who waited to receive CR

		Group 1: usual care waited x 12 wk. **Group 2:** immediate treatment	**Anxiety:** Norwegian HADS-A **Depression:** Norwegian HADS-D **24 weeks (12 wks post program):** **Same as 12 wk** **- Exercise capacity** **-Adverse events** **-Arrhythmias and safety** **- Anxiety** **- Depression** **Comprehensive CR appraisal** Appraisal Questionnaire: n (%)	18(in 2 pts) - During the 12 wk before the program (control period): 20 (in 1 patient) **Anxiety** HADS-A Ex (12 wk post-program): 8.1±3.6 C (control period): 13.3 ±2.5 P=NR **Depression** HADS-D EX (during program): 6.7±2.9 C (control period): 9.5±3.2 P=NR **24 weeks (12 wks post program):** **Exercise capacity** **Exercise time** All: 11:20± (2:17) P=NS **Adverse events** ICD shocks During 12 wk after the program: 2 (in 2 pts) **Arrhythmias and**	

				safety SVT - During 12 wks after the program: 2 (in 2 pts) NSVT - During 12 wks after the program: 22 (in 4pts) **Anxiety** HADS-A **All:** 6.1±4.5 P=.60 **Depression** HADS-D **All:** 5.5±3.9 P=.75 **CR appraisal** - Very beneficial: 10 (77%) - More confident to exercise: 11(85%) - Feel more positive: 10 (77%)	
Frizelle et al (2004)[34]	**Design:** RCT, cross-over (n=21) **Samples:** ICD for uncontrolled	**EX**: Hospital-based cognitive-behavioral CR program: 2h/wk	**12 wk:** **Anxiety** HADS-A	**12 wk** **Change scores** **Anxiety** HADS-A EX: -1.08±1.24	**Level of Evidence:** II **Jadad score =** 2 **Strengths**

	ventricular arrhythmia (100%) Time since ICD implantation: NR **Device:** ICD for secondary prevention **Gender:** n(%): NR **Ethnicity:** NR **Age:** 61.6±7.4y EX: 60.4+10.13y C: 62.6+4.7y **LVEF%:** NR **Dropout rates:** **12 weeks** Group 1: immediate participation 0% Group 2 waiting group 0% **3 months** Group 1: 0% Group 2: 10%	x 12 wk + home exercise - Educational and discussion sessions about ICD concerns - Muscular relaxation; Breathing retraining - Setting and pacing meetings; - Educational session on anxiety, ICD and ECG - Support group (n=12) **C:** Routine care wait x 12 wk, then 12 wk of CR (n=10)	**Depression** - Change scores HADS-Depression **ICD Total Concerns Questionnaire (TCQ)** Number Severity **QOL** -MacNew QOL after MI (MacNew QLMI) -Euroqual **Shuttle walk test** Heart rate Level of difficulty T otal distance walked (m) Borg rating **6 mo** Same as 12 wk	C: -0.10 P=.01 **Depression** HADS-D EX: -1.58±1.16 C: -0.10 P=.001 **TCQ** Number EX: -4.25±4.49 C: -0.20 P=.007 Severity EX: -10.00±10.01 C: 1.00 P=.006 **QOL** MacNew (Emotional) EX: 0.42±0.69 C: 0.06 P=.05 MacNew (Physical) EX: 0.69 ±0.74 C: 0.03 P=.008 MacNew (Social) EX: 0.87±0.82 C: 0.10 P=.004	- Study design: All participants received the intervention **Limitations** - Small sample - Many values for actual outcomes are not provided, only change scores - Population characteristics not described ie gender, ICD type, LVEF). - P values not reported for many comparisons - SD not reported for many values

				MacNew (Global) EX: 5.40±0.65 C: 0.06 P=.005 Euroqual EX: 9.58±6.82 C: 1.56 P=.05 **Shuttle walk test** Heart rate EX: 0.00±0.00 C: 0.00 P=NS Level EX: 1.37±0.65 C: 0.00 P=.050 Distance EX: 85.56±24.13 C: 0.32 P=.01 Borg rating EX: 5.60±1.90 C:5.40 P=NS **6 mo:** Total sample **Anxiety**	

				HADS- A 3.9±3.07 P=.001 **Depression** HADS- D 1.73±1.90 P=.003 **TCQ** Number 8.59±6.04 P=.000 Severity 11.09±9.79 P=.000 **QOL** MacNew (Emotional) 5.96±1.18 P=.000 MacNew (Physical) 5.86±1.23 P=.000 MacNew (Social) 6.12±1.45 P=.000 MacNew (Global) 5.98±1.25 P=.000	

				Euroqual 84.95±18.50 P=.001 **Shuttle walk test** Heart rate 23.59±4.88 P=NS Level 8.45±6.47 P=.000 Distance 463±27.79 P=.000 Borg rating 5.65±0.42 P=NS **Adverse Events:** 1, died not cardiac related	
Vanhees at al., (2004)[35]	**Design:** case-control study, ICD=92 Control=473 **Sample:** consecutive patients with ICDs from 2 centers, time since implant median 7 weeks	**EX (cases):** ICD patients who participated in supervised exercise training programme (90 min/3X/week/12 weeks, at 50–80% of maximal HR) (n=92); outdoor activities such as walking	**12 wk** **Exercise apacity** PeakVO_2(mL/kg/min) Peak O_2pulse mL/beat Maximum HR (bpm) **Arrhythmias during ex testing** PVC SVT VT	**12 wk** **Exercise apacity** PeakVO_2 EX: 20.3±4.8 C: 27.8±6.9 p<.001 O_2pulse EX: 13.3±4.4 C: 15.4±3.5 P<.001	**Level of Evidence:** IV **Jadad score =** NR **Strengths** - Larger sample size - Careful description of interventions and adverse outcomes **Limitations** - ICD sample

	Device N ICD: single-chamber, dual-chamber, bi-ventricular) devices **Gender N**: EX: Male: 79 Female: 13 C: Male: 428 Female: 45 **Age** (mean ± SD) EX: 57±12y UC: 56±7.8y **Ethnicity:** NR **ICD indication:** NR **LVEF%** EX: 23 with EF <40% C: 41 with EF <40% **Dropout rate:**	and jogging, strength & endurance training and recreational sports were added to the training program **C:** 473 cardiac patients without an ICD who had a CPET and completed CR program x 12 wk **All patients**: 4-5 education sessions related to heart disease, psychology, diet.	**Adverse events** ICD shocks	Max HR EX: 125.8+20.2 C: 136.8+18.8 P=.99 **Arrhythmias exercise testing** PVC EX: 18 (20%) C: 47 (10%) P<0.01 SVT: ICD: 9 (10%) C: 112 (24%) P<.01 VT during testing 1: VT without ICD shock **Adverse events** 1 VT during training, ICD shock x 1 1 inappropriate ICD shock 6 appropriate ICD shocks outside of training sessions	consisted of patients referred to different rehabilitation programs (Leiden/Leuven). - Controls were patients without an ICD - Nonrandomized design - Both groups participated in exercise program.

	EX: 14 pts (13.2%) 4 moved; 6 noncardiac comorbidity; 4 ICD shocks related to VT C: NR				
Davids et al (2005)[36]	**Design:** Retrospective telephone survey comparative study (n=82). No patients underwent exercise interventions conducted by the study. **Sample:** Coronary artery disease and ICD between 1997 and 2001 -Time since ICD implantation (mo) EX: 55±6 C: 43±4 **Gender:** n**(%)**: Male: 71(86.59)	**EX:** any outpatient CR program (n=28) **C:** no CR (n=54)	**Telephone survey conducted in 2005:** **Exercise capacity (self-report)** - METs (per wk) - Frequency of regular exercise (times/wk); median - Exercise >3 times/wk (times/week) n(%) - Decrease in exercise after ICD implantation (times/wk) **Adverse events (EHR)** **ICD shock** - Any shock n(%) - Appropriate shock n(%) - Inappropriate shock n(%) - Shocks during exercise n(%) - Appropriate shock during exercise n(%)	**At time of survey:** **Exercise capacity (self-report)** METs EX: 5.3 C: 3.5 P<.02 Frequency of regular exercise (times/week) EX: 4 C: 3 P=.11 Exercise >3 times/ wk n(%) EX: 23(82) C: 31(57) P<.30 Decrease in exercise after ICD implantation EX: 8(28) C:24(44) P=.15	**Level of Evidence:** IV **Jadad score =** NA **Strengths** - Larger sample - Careful account of ICD shocks confirmed by medical record **Limitations** - Excluded patients with NYHA III and IV; - Heterogeneity of the exercise intervention, participants had different dosage of exercise; - Absence of older patients; - Level of activities and participation in outpatient cardiac rehabilitation was self-reported; - It was a telephone survey, so patients

	Female: 11(13.41%) **Age:** 61±1.25y EX: 60 +1.5y C: 62+1y **Ethnicity**: NR **ICD indication** Primary: EX: 12(43%) C: 25(46%) Secondary: EX: 16(56%) C: 29(53%) **LVEF%** EX: 37+2 C:35+2 **Dropout rate:** NR		-Inappropriate shock during exercise n(%)	**Adverse events** **ICD shock** Any shock EX: 7(25) C: 27(50) P=.03 Appropriate shock EX: 4(13) C: 21(39) P=.03 Inappropriate shock EX: 5(18) C: 17(31) P=.17 Shocks during exercise EX:0(0) C:9(16) P=.02 Appropriate shock during exercise EX: 0(0) C: 7(13) P=.02 Inappropriate shock during exercise EX: 0(0) C: 4(7) P=.10	without a telephone were excluded

				Adverse events See above	
Belardinelli et al (2006)[1]	**Design:** RCT (n= 52) **Sample:** NYHA II heart failure ischemic cardiomyopathy (time since ICD implantation within previous 3 mo) **Device: with or without CRT** -Guidant ICD=100% -Guidant CRT-D =100% **Gender:** n**(%)**: Male: 52(100) Female: 0 (0) **Age:** EX: 55.1±14y C: 53.1±15y **ICD indication Primary:** EX: 18 C: 15 **Secondary:** EX: 12	**EX:** Aerobic exercise (1h 3x/ wk at 60% peak VO_2 HR x 8 wk) ICD: n=15 CRT-D: n=15 **C:** Avoid physical training (n=22) ICD: n=12 CRT-D: n=10	**8 wk:** **Exercise capacity** PeakVO_2 (mL/kg/min) AT **Endothelial function** Brachial artery reactivity (relative diameter change %) **LVEF%** **QOL** MLHFQ **18 mo** **Arrhythmias and safety** Deaths Sustained ventricular tachycardia Frequency of hospitalizations (rate) **Adverse events** ICD shocks	**8 wk:** **Exercise capacity** PeakVO_2 EX: 18.9+/- 2.7 C: 16.1+/-2.2 P<.001 AT EX: 13.5+1.9 C: 10.3+1.9 P<.001 **Endothelial function** Diameter change % EX:8% C: 8% P=NS **LVEF** EX: ICD: 33+7 CRT-D: 42+5 P=.001 C: ICD: 33+6% CRT-D: 33+6% P=NS **QOL** EX:50 C: 58 P=NS	**Level of Evidence:** II **Jadad score =** 3 **Strengths:** - Blinded interpretation on study results - Careful reporting of adverse outcomes **Limitations:** - Small sample sizes - No numerical value of brachial artery outcome presented or MLHFQ data - Higher hospitalization rate in those who exercised. - Changes in MLHFQ scores only in those with CRT-D

	C: 7 **LVEF%** (mean±SD) EX: 30.2±7 C: 33.6±8 **Dropout rate:** NR			**18 mo:** **Arrhythmias and safety** Deaths EX: 0 C: 0 **Sustained VT** (n) Ex: 0 C: 8 Hospitalization rate EX: 67% C: 45.4% P<.001 **Adverse events** ICD shocks: EX:0 C:8 events **Adverse Events:** No deaths and no complex ventricular arrhythmias during the training sessions and follow-up in exercise group.	
Dougherty et al (2008)[37]	**Design:** Single group pre-post (n=10) **Sample:** sudden cardiac arrest survivors (n=4) or	**Cases**: Supervised outpatient aerobic exercise (3h/wk + home walking 2h/ wk x 8 wk: at 60% to 80% of maximal	**8 wk:** **Exercise capacity** Exercise time(min:sec) Peak VO_2 (mL/kg/min) METs Max HR **HR variability**	**8 wk** **Exercise capacity** Exercise time Pre: 9:17+5:18 Post: 10:22±5:56 P =0.04 Peak VO_2	**Level of Evidence:** V **Jadad score =** NR **Strengths** **-** HRvariability measures - Excellent adherence to exercise intervention

	sustained ventricular arrhythmia (n=6), with ICD implant in previous 6 mo **Gender:** n(%): Male: 9 (90%) Female: 1 (10%) **Age:** (meanSD)**:**_ 54.82±9.73 **Ethnicity** Caucasian 100% **ICD Type**: NR **ICD indication:** 100% Secondary prevention **LVEF%** 39.18±19.79 **Time since ICD implantation**: ND **Dropout rates**: 0%	heart rate. Remaining 4 mo: walk for 30 min/all or most days	SD of R-R intervals Low frequency (LF) power High frequency power (HF) **QOL** SF-12 PCS SF-12 MCS **Psychological** - STAI **-** CES-D **Biomarker** hsCRP **6 mo:** **Heart rate variability** SD of R-R Intervals LF HF **QOL** SF-12 PCS SF-12 MCS **Psychological** STAI-Anxiety CES-D Depression	Pre: 25.59+9.29 Post: 26.00±11.30 P=.78 METs Pre: 6.63+2.61 Post:: 7.00±2.94 P=.33 Max HR Pre: 137.6+19.2 E: 136.7±14.7 P=.89 **Heart rate variability** SD R-R Intervals Pre: 823.33 ± 173.03 Post:911.33±137.58 P=.05 LF Pre:429.58 ± 357.70 Post:620.75±514.25 P=.58 HF Pre: 143.5 ± 125.88 Post: 227.69±294.27 P=.36 **QOL** SF-12 PCS Pre: 44.33±10.77 Post: 47.19±9.11 P=.19	**Limitations** - No control group - Small sample size

	Participants exercised more than was required			SF-12 (MCS) Pre: 51.33±11.68 Post: 55.03±8.04 P=.48 **Anxiety** STAI Pre: 31.56±11.83 Post: 28.22±9.68 P=.06 **Depression** CES-D Pre: 11.00±13.08 Post: 9.22±11.88 P=.46 **Biomarker** hsCRP Pre:6.56±3.78 Post: 4.33±2.61 P=.69 **6 mo:** **Heart rate variability** SD R-R intervals Pre: 823.33±173.03 Post: 900.89±145.87 P=NR LF Pre:429.58±357.70 Post: 572.5±422.11 P=.58 HF	

				Pre: 143.5±125.88 Post: 229.03 ±196.79 P=NR **QOL** SF-12 PCS Pre: 44.33± 0.77 Post: 49.36±9.14 P= NR SF-12 (MCS) Pre: 51.33±11.68 Post: 49.43±8.38 P=.48 **Anxiety** STAI Pre: 31.56±11.83 Post: 33.6±14.29 P=NR **Depression** CES-D Pre: 11.00±13.08 Post: 10.4±12.62 P=NR **Adverse events** -No sustained arrhythmias during exercise testing or exercise interventions. -No ICD shocks.	
Fan et al **(2009)[38]**	**Design:** Retrospective case-controlled	**EX (cases):** Supervised exercise training	**Safety** Hospitalizations Death	**Safety** Hospitalizations EX: 4	**Level of evidence:** IV **Jadad score =** NR

	chart review (n=84) between 1992-2005 at single center **Sample:** ICD patient and controls who participated in CR. **-**Time from ICD implantation (d) 277±366 **Gender:** n(%): Male: EX: 32 (76%) C: 33 (79%) **Age:** (mean±SD) EX: 61±12y C: 61±14y **Ethnicity:** NR **ICD indication** **Primary** 10(24%) **Secondary** 32(74%) **LVEF%** ICD: 32±15 C: 36±13	in CR (intensity of 50% to 85% of heart rate reserve using telemetry monitoring for 30-60 minutes/3 times/wk using various upper and lower body training modalities) (n=42) **C (sample):** Matched controls without ICDs who participated in CR as defined above, match was based on LVEF, age, gender. (n= 42)	**Adverse event ICD shocks** ICD firings (at the rehabilitation center) CPR **Exercise capacity** METs achieved at end of program	C: 1 **Adverse event** **ICD shocks during exercise** EX: 1 **ICD shocks outside of exercise** EX: 0 CPR: EX:0 C:0 Death EX: 0 C: 0 **Exercise capacity** METs Ex: 30% improvement after CR C:37% improvement after training P=NS	**Strengths** - Relatively large sample size - Good tracking of adverse outcomes **Limitations** - Retrospective design - Actual values of outcomes not provided or P values

	Dropout rate: Dropouts secondary to cardiac reason: EX: 9% C: 12% **Attendance** Patient-sessions attended EX: 21+13 C: 22+13 P=.60 Completion rate% ICD: 45 C: 62 P=.12				
Piccini et al (2013)[39]	**Design:** Prospective RCT (total n=2331), n=1053 with an ICD **Samples** Outpatients with HF and EF <35% ICD or biventricular ICD -Ischemic cardiomyopathy	**EX:** Supervised aerobic exercise training (36 sessions 3×/wk x 4 y at 60- 70% target HR) followed by home-based exercise training 5×/wk x 9 mo (n=546) **C:** Usual care not restricted in activity	**3 mo:** **Exercise capacity** PeakVO_2(mL/kg/min), change from baseline EX (Mean, SE): With ICD at baseline Without an ICD at baseline **2.2 years f/u:** **Adverse events** - All cause ICD Shock - Hospitalization -Composite endpoint of	**3 mo** **Exercise capacity** PeakVO_2 (change) With ICD EX: 0.69 (0.12) C: 0.11 (0.12) P=NS Without an ICD at baseline EX: 0.91 (0.11) C: 0.31 (0.12) P=NS **2.2 y f/u:**	**Level of evidence:** II **Jadad score** = 2 **Strengths** - Long-term follow-up - Multicenter, international randomized trial - Largest study of exercise in HF patients with ICDs to date **Limitations** - Unblinded

	61% **Device:** ICD or CRT-D at baseline 1053 (45% of total) CRT-D EX: 41% C: 42% **Gender:** n**(%)**: Female EX: 113 (21%) UC: 109 (21%) **Age:** (median) EX: 61y UC: 60y **Ethnicity %** Caucasian EX: 70% C: 70% **ICD indication Secondary** EX: 28% C: 31% **LVEF%** (median) EX: 24; UC: 24 **Dropout rate:**	(n=507)	Shocks/death - Composite endpoint of death, myocardial infarction, or worsening HF	**Adverse events** ICD shock EX: 20% (108) C: 22% (113) P=NR Time to 1st ICD shock=11.4 mo Hospitalization ICDs 67%(709/1053) No ICD 63% (809/1278) ICD shock and death EX: 176 (32%) C:177 (35%) P=NR Composite endpoint of death, myocardial infarction, or worsening HF 41% in those with ICD	measurement of outcomes - Analysis included all patients with an ICD, including those implanted during follow-up - Appropriate and inappropriate cause of ICD shock could not be determined - Many data points between exercise and controls, with and without ICD are not provided

	EX: 35%				
Smialek et al (2013)[40]	**Design:** pre-post (n=45) **Sample:** 1st time ICD implantation at 6 wk after ICD implantation **Device:** **ICD** - Single-chamber ICD (VVI): 16 -Dual-chamber ICD (DDD): 29 **Gender** n: Female: 17 Male: 28 **Age** 62.2y **Ethnicity**: NR **ICD indication** **Primary** 39(86.7%) **Secondary** 6(13.3%) **LVEF:** 30.09±12.75	**EX:** Comprehensive CR: - 2-wk inpatient phase and 12-wk outpatient phase. **Inpatient Phase**: all types of training listed below. **3 types of training:** 1.Interval endurance training (repeated sequences of short exercise and a rest period) 2.Resistance training (15-20 min/1–2 sessions/ wk) 3.Respiratory muscle exercise **Outpatient phase 2 (12 wk)** Aerobic interval endurance training including or alternating with resistance training (20- 50min/5x/ wk/12wk	**12 wk:** **Exercise capacity** PeakVO_2(mL/kg/min) **(LVEF)%** **Depression** BDI **QOL** Polish version* of SF-36 scores Role limitation physical health Mental dimension Physical dimension (higher scores = lower QOL **Adverse events** Death or complication during exercise testing or training **Arrhythmias and safety** ICD shock Nonsustained VT without device intervention Including: Inappropriate ICD	**12 wk:** **Exercise capacity** PeakVO_2 Before: 21.3±9.2 After: 24.2±10.3 P=.007 **LVEF** Before: 30.09±12.75 After: 35.43±13.40 P=.002 **Depression (**BDI) Before: 14.81±9.27 After: 12.83±10.75 P=.02 **QOL** SF-36 Role limitation: NR Mental dimension:NR Physical dimension: significant improvement- data NR **Adverse events** Death= 0 Complication during testing or training=0 **Arrhythmias and safety** - NSVT without ICD	**Level of evidence:** IV **Jadad score** = NR **Strengths** - Training intensity and amount of exercise were determined individually taking into account ICD programming **Limitations:** - Small sample - Complex intervention dimensions - Lack of control group - QOL data not presented

	Dropout rate: NR		intervention Appropriate ICD intervention	shock=7 - Inappropriate ICD intervention=1(2.2%) - Appropriate ICD intervention=2 (4.4%) -No events during exercise interventions	
Toise et al (2014)[41]	**Design**: prospective RCT (n=55) **Sample**: ICD implant in prior 6 wk **Device** n**(%)** ICD **Gender:** n(**%)**: Male: EX:18(69%); C: 18(90%) Female: EX: 8(31%); C: 2(10%) **Age:** (mean ± SD) 66.3±13.3y **Ethnicity** Caucasian EX: 23 (92% C: 15 (94%)	**EX:** Gentle adapted Yoga program (consistent with daily life activity: breathing techniques, adapted physical postures relaxation, and meditation) for ICD patients (80 min weekly sessions/8 wk) + Standard medical care + 6 mo follow-up post-intervention (n=31) **C**: standard medical care with cardiac nurse follow-up for nonroutine device concerns + 5 monthly calls	**2 mo:** **Psychological** (change from baseline -CES-D) -Florida Patient Acceptance Survey (FPAS) -Positive Health Expectation Scale (PHE) -State-Trait Personality Inventory (STPI) -Symptom/Emotion Checklist (SEC) -Florida Shock Anxiety Scale (FSAS) -Self-Compassion Scale (SCS) -Interpersonal Support Evaluation (IPS) -Expression Manipulation Test (EMT) **Device therapies** required over 2 mo-6 mo f/u - ICD shocks -ATPs	**2 mo:** **Psychological** CES-D (mean±SD) EX: -2.77±8.85 C: 2.00 ±5.33 P=.07 FPAS EX: 4.94±17.81 C: −3.33±23.06 P=.21 PHE EX: .15±.37 C: .15±.37 P=.97 STPI EX: -3.44±11.15 C: -1.36±7.90 P=.54 SEC EX: -0.08±06.53 C: -3.71± 1.80 P=30 FSAS	**Level of evidence:** II **Jadad score** = 3 **Strengths** - Participants of both groups received a monthly call from one of the cardiac nurses **Limitations** - Modest sample size - Limited time in f/u - No physical health outcomes - No data presented related to ICD events; only regression to predict rate of ICD events.

	ICD indication: Primary prevention: 26 (56.5%) **LVEF%** 34.2 +14.7 EX:33.1 ±14.9 C: 35.4 ±15.0 **Dropout rate** n(%)**:** EX: (5) 16.1% C: (4) 16.7% Attendance EX: 7/8	from the cardiac nursing staff. (n=24)		EX: -1.24±3.82 C: 3.00±2.08 P<.0001 SCS EX: .24±52 C: -.29±.61 P=.007 IPS EX: -0.18±0.96 C: 1.00±2.94 P=.14 EMT EX: -0.10±0.55 C: .11± 33 P=.30 Device therapy - EX group had fewer expected ICD events over 8 mo, results were not presented for the events/group	
Berg et al (2015)[42] **Berg et al (2015)**[43] **Christensen et al (2015)**[44]	**Design:** Prospective RCT (n=196) **Sample:** 1st time ICD implantation; exercise starts 3 mo from implantation	**EX** (n=99): **aerobic and resistance training** (aerobic exercise + resistance + psych-education; 1h x 2x wk with 50-80% of estimated	**3 mo:** **Exercise capacity** PeakVO_2 (mL/kg/min) **QOL** SF-36 GH SF-36 MCS	**3 mo:** **Exercise capacity** PeakVO_2 (mL/kg/min) EX:20.98±7.98 C:20.88±7.8 P=NS **QOL** SF-36 GH EX:62.8±20.9	**Level of Evidence:** II **Jadad score =** 3 **Strengths:** - Large sample size - Use of register-based follow-up information - One of the few studies that report cost-analysis

	-VF arrest prior to ICD 20% each group LVEF%<35% 32.2% both groups **Gender:** n (%): Male: EX: 79 (80%) C: 76 (78%) **Age:** (mean ± SD) EX: 57.6±12.9y C: 56.7±3.5y **ICD Type:** **ICD indication:** Primary EX: 63 C: 67 Secondary EX: 36 C: 30 **LVEF%** EX: 32.2(17) C: 32.7(18) **Dropout rate at 3 mo:**	HR x 12 wk **Psych-educational** 1x mo x 6 mo & then every 2 mo x 1 y; total sessions= 9 (n=99) **C** (n=97): 2-h group session on the ICD x 1	**Gender differences** PeakVO_2 (mL/kg/min) Exercise time (min) **6 mo:** Same as 3 mo **Gender difference** **12 mo:** **QOL** **Gender difference** **Hospital admission** Time to first admission (d) Time to first after heart admission (d) **3 y:** **Hospital admission** Time to first admission (d) Time to first acute heart admission (d) **ICD Therapy** ATP ICD Shock **Mortality** **Costs**	C: 64.4±21.8 P=NS SF-36 MCS EX:51.7±8.6 C:51.9±11.54 P=NS **Gender difference** PeakVO_2 (mL/kg/min) - Male EX: 20.9±8.1 C:22.1±8.1 P=.01 - Female EX:21.4±7.8 C: 16.8±5.1 P=.17 Exercise time (sec) - Male EX: 587±249.6 C: 613±264.7 P=.01 - Female EX: 481.3±174.6 C: 391.5±145.4 P=.29 **6 mo:** **Exercise capacity** PeakVO_2 (mL/kg/min) EX:23.011±8.91 C:20.79±8.1	**Limitations:** - Statistical analysis did not report the baseline information - No blinding to outcomes - Some patients in the usual care received intervention - Some patients started rehabilitation earlier - No information on attendance at CR - Usual care contaminated by information during inclusion suggesting the benefits of intervention - Not all outcomes reported at 3 y - No drop out rate for 36 mo - Only appropriate therapy was included under ICD therapy.

	EX:13.1% C:18.6 %		- Hospitalization costs (US$) - Outpatient treatment costs (US$) - Total costs (US$)	P=NR SF-36 MCS EX:53.6±9.4 C:51.0±11.0 P=NS **Gender difference** PeakVO_2 (mL/kg/min) - Male EX: 23.4±9.5 C:21.8±8.3 - Female EX:21.7±7.8 C: 17.1±6.1 Total exercise time (sec): - Male EX: 650.7±279.8 C:606.1±277.3 - Female EX:517.5±180.9 C:399.4±175.6 **12 mo:** **QOL** SF-36 MCS EX:54.3±7.4 C:51.2±10.0 P=NR Hospital admission EX: 41(41.4%) C: 37(38.1%)	

				P=.53 **Gender difference** SF-36 PCS - Male EX:47.0±9.6 C:47.4±9.2 - Female EX:46.8±12.1 C:40.6±12.3 SF-36 MCS - Male EX: 54.8±7.1 C: 51.9±9.6 - Female EX: 52.2±8.6 C: 48.5±11.4 **Hospital admission** Time to first admission EX:41±41.4 C:37±38.1 P=.53 Time to first acute heart admission EX:26±26.3 C:24±24.7 P=.37 **3 y:** **Hospital admissions**	

				Time to first admission EX:70±70.7 C:63±65.0 P=.35 Time to first acute heart admission EX:42±42.4 C:42±43.3 P=0.40 **ICD Therapy** ATP EX: 8.4±37.0 C: 13.8±92.5 P=.29 ICD shocks EX:0.6±2.0 C:0.5±1.5 P=.90 **Mortality** Mortality EX:19(19.2%) C:12(12.4%) P=.19 **Costs** Intervention costs: 335 Hospitalization costs: EX: 12 955	

				C: 20 061 Outpatient treatment costs: EX: 5825 C: 5668 Total costs: EX: 19 664 C: 16 199 **Adverse events:** see above	
Dougherty et al (2015)[6]	**Design**: prospective RCT (n=160) **Sample**: ICD recipients 3 y after implant Secondary: 92(57.5%) Primary: 68(42.5% **Gender:** n(%) Male: 124(77.5%) Female: 36 (22.5%) **Age** 54.9±12.2y EX: 56.1±12.1y C: 53.6±12.28y	**EX:** Home walking; phase1: 1 hr/d × 5 d/wk × 8 wk at 60-80% of HRR Maintenance Phase 2: Home walking 30 min/d × 5d/wk × 16 wk at 80% of HRR (n=84) **C:** No exercise directives. 5 monthly phone calls (n=76)	**8 wk:** **Exercise capacity** Peak VO_2 (mL/kg/min) Exercise time (min:sec) VO_2 at AT Time at AT (min:sec) O2 pulse (VO_2/HR) METs **24 wk:** **Exercise capacity** **ICD shocks** - During exercise - Total ICD shocks - Appropriate shocks **Hospitalizations** - Associate w/exercise - Total hospitalizations - Total individuals	**8 wk** **Exercise capacity** Peak VO_2 EX: 26.7±7.0 C:23.9±6.6 P=.002 Exercise time EX: 16:04±6:17 C:13:37±4:50 P=.001 VO_2 at AT EX: 22.5±6.2 C:20.0±5.5 P=.009 Time at AT EX: 12:42±5.21 C: 10:47±4.11 P=.001	**Level of Evidence:** II **Jadad score** = 5 **Strengths** - Blind to the outcomes - Large sample size - Dropouts low - Adherence outcomes carefully reported **Limitations** - All patients were in NSR at start of study - All patients taking beta blocker medications - Those over 400 lb could not participate - Those who could not walk on treadmill could not participate

	Ethnicity EX: Caucasian 88.1% C: Caucasian 80.3% **ICD device**: Single- or dual-chamber ICD **Diagnosis** VT/ VF 15.7% Ischemic cardiomyopathy= 43.1% Dilated cardiomyopathy= 30% **LVEF%** 40.6 ± 15.7 **Dropout rates:** 8 wk**:** EX: 6.6% C: 8.3% 24 wk**:** EX: 10.5% C:11.9% **Adherence** Phase 1: 76% Phase 2: 74.8%			VO_2/HR EX: 18.5±5.2 C:17.1±5.0 F=3.20 P=.07 METs EX: 7.57±2.04 C:6.77±1.97 P=.005 **24 weeks:** **Exercise capacity** Peak VO_2 EX: 26.9±7.7 C:23.4±6.0 P<.001 Exercise time EX: 16:27±6:36 C:13:24±4:33 P<.001 VO_2 at AT EX: 23.0±6.8 C:19.8±5.8 P=.001 Time at AT EX: 13:16±5:45 C:10:38±4:03 P<.001 VO_2/HR EX: 1.7±5.5	

				C:16.8±4.9 P=.01 METs EX: 7.64±2.26 C:6.67±1.82 P<.001 **Adverse events** **ICD shocks** Associated w/exercise EX:0 C:0 Total ICD shocks EX: 4 C: 8 Total individuals EX: 3 C: 4 Appropriate shocks EX: 2 C: 5 **Hospitalization** Associate w/exercise EX: 0 C:0 Total EX:11 C:11	

				Total individuals EX:9 C:9	
Isaksen et al (2015)[45] **Isaksen et al (2016)**[46]	**Design:** Prospective, controlled, nonrandomized (n=38) **Sample:** Ischemic HF primary and secondary prevention, first-time ICD or CRT-D **Device** n(%) **ICD only EX:** 19(79) **C:** 10 (91) **CRT-D: EX:** 5 (21) **C:** 1(9) **Gender:** n(%): **Male** EX: 21 (88) C: 11 (100) **Age** (mean ± SD) EX: 65±9y C: 69±9y	**EX:** Outpatient CR aerobic training **(**60 min/3x/wk/12 wk, 60-70% of max HR, Borg 11-13 - 4 4-min intervals at 85% of maxHR, Borg 15-17 (n=26) **C**: Controls were those unable to attend exercise sessions. (n=12)	**12 wk:** **Exercise capacity** PeakVO_2(mL/kg/min) **(LVEF%** **Arrhythmias and safety** - Antitachycardia pacing (ATP) - NSVT shocks **Endothelial function** Brachial artery reactivity (relative diameter % change **QOL** Norweign SF-36 MCS SF-36: PCS **Anxiety** HADS-A **Depression** HADS-D	**12 wk** **Exercise capacity** PeakVO_2 EX: 18.4±5.3 C: 16.2±2.7 P<.05 **LVEF** Pre EX: 37.6+10.9% Post EX: 39.3 ± 10.5% P=.008 C=NR P=NS **Arrhythmias and safety** ATP/NSVT (training period total) EX: 1/5 C: 1/4 P=NR Shock EX: 0 C: 0 P=NS **Endothelial function** Diameter change EX: 9.95 ± 3.92 % C: 6.93 ± 4.50 % P<*.05*	**Level of Evidence:** III **Jadad score** = 2 **Strength** -No adverse noted -Low drop out rate **Limitations** -Small sample -Non randomized study -Data points and p values not report for several outcomes

	ICD Indication **Primary** EX: 11 (46) C: 6 (55) **Secondary** EX: 13 (54) C: 5 (45) **LVEF%** (mean ± SD) EX: 37.6±0.9 C: 30±8.1 **Dropout rate** EX: 9.2% C: 8.0%		**24 mo:** **QOL** SF-36 MCS SF-36 PCS **Anxiety** HADS-A **Depression** HADS-D **Time in sedentary & physical activities** - IPAQ - Time spent sitting during daytime - METs (min/wk) **Adverse events: ICD therapies** **All cause hospitalizations rate**	**QOL** **MCS** EX: 59 C: 54.9 P=NR **PCS** EX: 47.1 C: 41.3 P=NR **Anxiety** HADS-A EX: 2.8 C: 5.1 P=NR **Depression** HADS-D EX: 1.8 C: 3.6 P<.05 **24 months** MCS (mean) EX: 57.6 C: 51.4 P=NR PCS (mean) EX: 46.1 C: 35.3 P= NR	

				Anxiety HADS-A EX: 3.2 C: 4.9 P=NR **Depression** HADS-D (mean) EX: 2.7 C: 5.1 P<.05 **Time in sedentary and physical activities** Time spent sitting/daytime EX: 340 min/d C: 585 min/d P=.04 MET-min/week EX:1398 C: 520 P=.10 **Adverse events ICD therapies** - During exercise EX:0 C:0 - Follow-up EX: 7 shocks in 2 pts C: 6 shock in 4 pts. P=.10	

				- All cause hospitalization EX: 1/patient C: 0.8/patient P=NS	
Lau et al (2016)[47]	**Design:** Single sample pre-post design (n=301) **Sample:** Initial ICD implant, 1 mo after ICD implantation for primary or secondary prevention **Gender:** n(%) Male: 222(73.8%) Female: 79(26.2% **Age:** (mean ± SD): 64.1±11.9y **ICD device:** Single or dual chamber ICD or CRT-D **ICD Indications:** - Primary:	**EX:** 12-week telephone-based home walking self-efficacy intervention (30min/d/12wk at 60-80%) - Individualized program at a level that they were capable of performing before the ICD implant. - Nurse weekly call to monitor exercise tolerance	**3 mo:** **Safety** **-** ICD shocks - ATP therapies - Total hospitalizations n(%) **Efficacy** - Daily physical activity (StepWatch) in steps/d - ICD self-efficacy score (Sudden Cardiac Arrest-Self-Efficacy scale) - Physical Activity Behaviors Questionnaire	**3 mo:** **Safety** - ICD Shocks 19(6.3%) - Total shock events:28 - Appropriate ICD shocks 15 (53.6) - Inappropriate ICD shocks 13 (46.4) - ICD shocks associated w/exercise 2 (7.1%) - ATP therapies - Total ATP events: 72 - Appropriate ATP 61 (84.7) - Inappropriate ATP 11 (15.3) - ATP associated with walking 2(2.8%) **Hospitalizations N(%)** Total individuals 40 (13.3%) -Total hospitalizations: 54 -Hospitalizations assoc with ICD shock or ATP 5 (9.2%) - Hospitalizations associated with ICD shocks and walking: 0	**Level of Evidence:** VI **Jadad score:** NA **Strength** - Early walking protocol - Telephone delivered rehabilitation - Large sample - Individualized home-based walking program - Data were verified with medical records. - Daily physical activity was measured using the StepWatch **Limitations** - Design precludes inferring that the intervention caused increases in physical activity - Not everyone began at the same intensity level or reached the same total minutes of walking/wk

	180(59.8) -Secondary: 121(40.2) **LVEF%** ≤35%: 206 (68.4) >35%: 95 (31.6) **Time since ICD implantation**: -1 month after implantation (4 wk after discharge) **Dropout rate:** Pre-post 9.6%			(0%) **Efficacy** **-** Daily physical activity - Total steps/d Pre: 6981.1_3639. Post: 7787.8±3990.8 P<.001 Self-efficacy scale score Pre: .98±1.73 Post: 9.05±1.16 P<.001 Physical activity behaviors Pre: 0.74±0.54 Post: 1.23±0.75 *P*<.001 **Adverse events** See safety outcomes	

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<u>Final List ICD</u>

Total: 17 Citations

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Table abbreviations: AT, anaerobic threshold; ATP, anti-tachycardia pacing; BDI, Bech Depression Inventory; C, Control; DES-D, Centers for Disease Epidemiolgy-Depression scale; CPET, cardiopulmonary exercise test; CR, cardiac rehabilitation; CRT, cardiac resynchronization therapy; CRT-D, cardiac resynchronization-defibrillator; CPR, cardiopulmonary resuscitation; EX, exercise intervention; EHR, electronic hospital record; f/u, follow-up; HADS-A, Hospital Anxiety Depression Scale-Anxiety; HADS-D, Hospital Anxiety Depression Scale-Depression; HF, heart failure; HR, heart rate; HRR, heart rate reserve; hsCRP, high-sensitivity C-reactive protein; ICD, implantable cardioverter defibrillator; IPAQ, Internation Physical Activity Questionnaire; LVEF, left ventricular ejection fraction; METs, metaboloic equivalents; MLHFQ, Minnesota LivingNYHA, New York Heart Association; PVC, premature ventricular contraction; QOL, quality of life; RCT, randomized controlled trial; SD, standard deviation; SE, standard error; SF MCS, Short Form-12 Mental Composite Summary; SF-12, Short Form-12 Physical Composite Summary; STAI, State-Trait Anxiety Inventory; SVT, sustained ventriculat tachycardia; UC, usual care; VF, ventricular fibrillation; VO_2, oxygen uptake; VO_2/HR, oxygen pulse; VT, ventricular tachcardia.