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Lipid Targets in Clinical Practice: Successes, Failures and Lessons to be Learned

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2 **Lipid targets in clinical practice: successes, failures and lessons**
3 **to be learned**

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8 **Abstract**

9 *Introduction* Optimal risk factor control is integral to
10 managing patients with proven coronary heart disease
11 (CHD+) and for those at risk of coronary heart disease
12 (CHD-). The primary aim of the study was to assess the
13 success rate of reaching lipid risk factor targets in a mul-
14 tiple risk factor clinic.

15 *Methods* A retrospective audit was conducted in 488
16 patients (CHD+, $n = 112$; CHD-, $n = 376$) who attended
17 the Cardiovascular Risk Factor Clinic at Tallaght Hospital,
18 Dublin in 2009 and 2010.

19 *Results* Risk factor targets achieved in CHD+ and
20 CHD- patients were LDLc (54/62 %), HDLc (67/67 %),
21 systolic blood pressure (35/38 %), diastolic blood pressure
22 (82/75 %), smoking cessation (27/26 %), BMI ≤ 30 (39/
23 50 %) and normal waist circumference (27/39 %). Patients
24 not reaching LDLc targets were found to be receiving
25 fewer lipid-lowering drugs and having higher LDL levels
26 at the initial clinic visit than those reaching targets.

27 *Discussion* This retrospective audit highlights gaps in
28 achieving target lipid levels at a multiple risk factor clinic
29 level. High initial LDLc levels and lack of drug titration are
30 evident. Guideline changes, staff rotation, clinic visit fre-
31 quency and multiplicity of targets may be contributory.
32 More emphasis needs to be placed on education and
33 algorithm-based strategies to achieve better risk factor
34 control.

35
36 **Keywords** Risk factor audit · Lipid targets ·
37 Cardiovascular risk factors · Coronary heart disease ·
38 Obesity · Blood pressure

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Introduction

39
40 Coronary heart disease (CHD) is a major cause of mor-
41 bidity and mortality in the developed world. Many risk
42 factors have been identified which have a strong associa-
43 tion with CHD, such as raised low-density lipoprotein
44 cholesterol levels (LDLc), reduced high-density lipoprotein
45 cholesterol levels (HDLc), hypertension, diabetes, smoking
46 and increased waist circumference [1–5]. Treating these
47 risk factors is critical to reducing the burden of CHD.
48 While controlled drug trials have yielded significant risk
49 factor improvements resulting in reduced cardiovascular
50 events, such successes are not equally matched in clinical
51 practice [6]. Assessing risk factor modification in clinical
52 practice may therefore help identify where problem areas
53 exist. Exploring these areas and identifying their associa-
54 tions may be important in achieving better risk factor
55 control.

56 Our aim was therefore to perform a retrospective audit
57 of our risk factor clinic to identify how well risk factors
58 were being controlled and examine if any patterns exist that
59 might guide future interventions.

Methods

60
61 The management of CHD and its associated risk factors
62 was assessed by a retrospective audit of patients ($n = 488$)
63 attending the Cardiovascular Risk Factor Clinic at Tallaght
64 Hospital in 2009 and 2010.

65 Patients were referred, with or without pre-existing
66 heart disease, to the clinic from their local G.P., other
67 hospital services or the occupational health department at
68 their place of work. The audit did not require ethical
69 approval.

70 CHD risk factors, including hypertension, abnormal
 71 blood lipid profile, hyperglycemia, BMI and smoking were
 72 recorded from each patient's initial clinic visit (Initial) and
 73 most recent (Latest) visits to the clinic (mean \pm SD:
 74 35 \pm 31 months). In addition to the major cardiovascular
 75 risk factors, age, gender, medication, family history and
 76 waist circumference were also recorded. LDLc values were
 77 calculated using the Friedewald formula [7] (LDLc = total
 78 cholesterol - (triglyceride/2.12 + HDLc)) and only used if
 79 triglyceride levels were $<$ 4 mmol/l. The values for 12
 80 patients could not be calculated because of triglyceride
 81 values $>$ 4 mmol/l. Patients were subdivided into those
 82 with coronary heart disease (CHD+, $n = 112$) and those
 83 without coronary heart disease (CHD - , $n = 376$).

84 Unpaired t test and Fisher's exact test were used to
 85 detect the absolute and relative differences between the
 86 CHD+ and CHD- groups (JMP Version 4.0, SAS Institute
 87 Inc., NC, USA). Data are presented as mean \pm SD unless
 88 otherwise stated.

89 Results

90 The average time interval between baseline and final visits
 91 was 35 \pm 31 months with 77 % of patients attending the
 92 clinic for at least 1 year.

93 The risk factor levels of all patients at the initial visit are
 94 outlined in Table 1. The CHD+ group was significantly
 95 older and received greater lipid-lowering therapies com-
 96 pared to the CHD- group ($p < 0.0001$). The mean total
 97 cholesterol, LDLc and HDLc levels (males) were signifi-
 98 cantly lower in the CHD+ group compared to the CHD-
 99 group ($p < 0.0001$). The presence of diabetes and stroke
 100 was significantly higher in the CHD+ group. While mean
 101 diastolic blood pressures were significantly lower in the
 102 CHD+ group, there was no significant difference in the
 103 percentage of patients with a history of hypertension or
 104 clinic-measured systolic blood pressures between the
 105 groups. Smoking status, waist circumference and BMI
 106 were not different between groups.

107 The impact of intervention in both groups attending the
 108 risk factor clinic is outlined in Table 2 where comparison
 109 of initial and latest clinic visits can be seen. Since targets
 110 for LDLc changed during the period of audit, both new and
 111 old target levels are included. There was a significant
 112 increase in the percentage of patients in both groups
 113 receiving lipid-lowering therapy at their latest clinic visit,
 114 which was particularly evident in the CHD- group who
 115 had $<$ 40 % lipid-lowering treatments at their initial visit.

116 90 % of patients taking lipid-lowering medication were
 117 receiving statin monotherapy. 50 % of patients were pre-
 118 scribed atorvastatin (10 mg 32 %, 20 mg 27 %, 40 mg
 119 27 % and 14 % dose not documented), 24 % were

Table 1 Baseline risk factor levels at initial clinic presentation according to CHD status

Risk variable	CHD+	CHD-	p
	$n = 112$	$n = 376$	
Age (years)	59 \pm 11	51 \pm 12	<0.0001
On lipid Tx	73 %	39 %	<0.0001
Total cholesterol (mmol/L)	4.8 \pm 1.2	5.5 \pm 1.3	<0.0001
LDL (mmol/L)	2.7 \pm 1.1	3.2 \pm 1.1	<0.0001
HDL male (mmol/L)	1.2 \pm 0.3	1.3 \pm 0.4	<0.05
HDL female (mmol/L)	1.5 \pm 0.3	1.6 \pm 0.4	NS
Triglyceride (mmol/L)	1.9 \pm 1.1	2.1 \pm 2.4	NS
Hypertension history	43 %	41 %	NS
Systolic BP (mmHg)	139 \pm 20	142 \pm 23	NS
Diastolic BP (mmHg)	82 \pm 14	85 \pm 15	<0.05
Smoking status			
Yes	23 %	31 %	NS
No	77 %	69 %	NS
Diabetes history	14 %	6 %	<0.05
Glucose (mmol/L)	5.9 \pm 1.6	5.3 \pm 0.7	<0.01
BMI (kg/m ²)	31.1 \pm 4.9	31.0 \pm 6.1	NS
WC male (cm)	102.1 \pm 11.4	102.7 \pm 13.5	NS
WC female (cm)	97.3 \pm 1.3	95.4 \pm 1.3	NS
History of CVA	10 %	4 %	<0.05
History of PVD	4 %	2 %	NS

Unpaired t test and Fisher's exact test were used to detect absolute and relative differences between CHD+ and CHD- groups. Data are mean \pm SD unless otherwise stated

LDLc low-density lipoprotein cholesterol, HDLc high-density lipoprotein cholesterol, BP blood pressure, BMI body mass index, WC waist circumference, CVA cerebrovascular accident, PVD peripheral vascular disease.

prescribed rosuvastatin (10 mg 55 %, 20 mg 29 %, 40 mg 120
 9 % and 7 % dose not documented), 10 % were prescribed 121
 pravastatin (10 mg 18 %, 20 mg 39 %, 40 mg 36 % and 122
 7 % dose not documented) and 7 % were prescribed sim- 123
 vastatin (20 mg 44 %, 40 mg 20 % and 36 % dose not 124
 documented). The remaining 9 % of patients were taking 125
 other lipid therapies. 126

127 There was a significant increase in the number of CHD- 127
 and CHD+ patients reaching LDLc target levels ($p < 0.01$) 128
 when the old LDLc target of $<$ 3.0 mmol/l was used, but no 129
 differences were observed when new target levels 130
 ($<$ 2.5 mmol/L) were used. 131

132 The percentage of patients achieving HDL targets was 132
 unchanged from initial to latest visits. The percentage 133
 reaching systolic blood pressure targets levels was 134
 unchanged, whereas the percentage of patients reaching 135
 diastolic blood pressure targets ($<$ 85 mmHg) significantly 136
 improved in both groups of patients. The percentage of 137
 nonsmokers increased in both patient groups, but this only 138
 reached significance in the CHD- group. The percentage 139

Table 2 Number and percent of patients reaching risk factor targets for initial and latest visits according to the CHD status

Targets	CHD+			CHD-		
	Initial	Latest	<i>p</i>	Initial	Latest	<i>p</i>
On lipid Tx	73 %	87 %	<0.05	39 %	68 %	<0.0001
New LDL target	42 (42 %)	54 (54 %)	NS	*140 (43 %)	*204 (62 %)	<0.0001
Old LDL target	63 (63 %)	81 (81 %)	<0.01	*140 (43 %)	*204 (62 %)	
HDL ≥ 1.0 M ≥ 1.3 F	83 (74 %)	75 (67 %)	NS	261 (71 %)	247 (67 %)	NS
Sys BP < 130	49 (44 %)	40 (35 %)	NS	136 (36 %)	143 (38 %)	NS
Dia BP < 85	71 (64 %)	91 (82 %)	<0.01	211 (56 %)	281 (75 %)	<0.0001
Nonsmokers	86 (77 %)	93 (83 %)	NS	260 (69 %)	290 (77 %)	<0.05
BMI ≤ 30	59 (53 %)	44 (39 %)	<0.05	186 (50 %)	188 (50 %)	NS
WC < 102 M < 88 F	38 (43 %)	24 (27 %)	<0.05	128 (41 %)	122 (39 %)	NS
Glucose < 6.2	28 (80 %)	24 (69 %)	NS	88 (84 %)	85 (81 %)	NS

LDLc data for 12 patients could not be calculated (Friedewald) because of high triglyceride values. Unpaired *t* test and Fisher’s exact test were used to detect absolute and relative differences between the initial and final visits

LDLc low-density lipoprotein cholesterol (new LDLc target based on <2.5 for CHD+ and <3.0 for CHD-, old LDLc target < 3.0 for CHD+). HDLc high-density lipoprotein cholesterol, Sys BP systolic blood pressure, Dia BP diastolic blood pressure, BMI body mass index, WC waist circumference, M male, F female

* New and old LDLc targets remain unchanged for patients without CHD

140 of patients in the CHD- group who achieved BMI and
 141 waist circumference target levels was unchanged. How-
 142 ever, the percentage of patients in the CHD+ group who
 143 achieved BMI and waist circumference target levels was
 144 significantly reduced compared to the initial clinic visits.

145 The factors associated with achieving or not achieving
 146 LDLc targets in both groups are outlined in Table 3. The
 147 only notable factor in the CHD+ group was that those
 148 reaching LDLc targets had also a significantly greater
 149 increase in HDLc levels. In contrast, in the CHD- group,
 150 those achieving LDLc target levels were older, male, had
 151 lower baseline LDLc levels and were on lipid-lowering
 152 medication. Reaching LDLc targets did not relate to weight
 153 changes.

154 Table 4 outlines the factors associated with reaching
 155 HDLc targets in both groups. Patients in the CHD+ group
 156 achieving HDLc targets were older, had higher HDLc
 157 levels initially and were on less lipid-lowering drugs when
 158 initially reviewed.

159 In the CHD- group, the patients reaching HDLc targets
 160 had significantly higher baseline HDLc levels and there
 161 was a greater proportion of males than females. There was
 162 also a significantly greater reduction in systolic blood
 163 pressure in those reaching HDLc targets.

164 **Discussion**

165 This retrospective audit gives some insight into how car-
 166 diovascular risk factors are being managed in clinical
 167 practice. Given the high risk population involved, it is

noteworthy that 87 % of patients with proven CHD were on
 lipid-lowering therapy and over 80 % had achieved LDLc
 levels <3.00 mmol/L with 54 % achieving LDLc levels
 below 2.50 mmol/l. These findings are not as good as pre-
 vious studies where 73 and 79 % of patients achieved target
 LDLc levels (< 2.50 mmol/L) [8, 9]. However it must be
 noted that patient data recorded for the present study was
 based on older LDLc guidelines (< 3.00 mmol/L).

LDLc target achievement was similar to that observed in
 the EUROASPIRE studies where ~ 54 % of patients
 achieved target total cholesterol (< 4.5 mmol/L) [10].

Statin therapies were either not started or not uptitrated
 in 77 % of CHD- and 80 % of CHD+ despite patients
 failing to achieve LDLc targets. Previous research also
 reports that in the majority of patients, statin doses remain
 unchanged regardless of improvements, or lack thereof, in
 LDLc control. [10] In the current study, 57 % of CHD+
 patients who were uptitrated achieved LDLc targets. This
 further emphasizes the need for clinicians to constantly
 review and uptitrate medication where possible.

Age, gender, weight changes, blood pressure changes,
 percent on lipid-lowering treatment and drug doses were
 not influencing factors in reaching target LDLc levels in
 those with CHD. In patients without CHD, it is not
 surprising that factors such as age, male gender and
 initial LDLc levels were the significant factors associated
 with reaching targets as they would all be considered
 reasons to treat. Overall, the main explanation why some
 patients reached targets whereas others did not appeared
 to be better response to treatment as judged by the
 greater LDLc reductions and HDLc increases. 77 % of

Author Proof

Table 3 Factors affecting the achievement of LDLc targets at the latest visit

	LDL targets		<i>p</i>			<i>p</i>
	CHD+			CHD-		
	Reached <i>n</i> = 57	Not reached <i>n</i> = 48		Reached <i>n</i> = 226	Not reached <i>n</i> = 136	
Age (years)	62 ± 10	65 ± 10	NS	55 ± 12	51 ± 13	<0.01
Gender M:F	39:18	25:23	NS	111:115	48:88	<0.05
Initial LDL (mmol/L)	2.5 ± 1.2	3 ± 0.9	NS	3.0 ± 1.0	3.6 ± 1.2	<0.0001
LDLc Δ	-14.5 %	8.8 %	<0.01	-19.0 %	10.8 %	<0.0001
HDLc Δ	8.9 %	-3.1 %	<0.05	-2.1 %	0.3 %	NS
SBP Δ	0.2 %	-1.0 %	NS	-2.6 %	-1.3 %	NS
DBP Δ	-3.5 %	-3.3 %	NS	-4.6 %	-5.9 %	NS
BMI Δ	1.7 %	1.1 %	NS	1.2 %	1.8 %	NS
WC Δ	3.3 %	4.6 %	NS	2.2 %	1.6 %	NS
On lipid Tx initial	74 %	69 %	NS	45 %	29 %	<0.01
On lipid Tx latest	92 %	79 %	NS	77 %	51 %	<0.0001

LDLc low-density lipoprotein cholesterol, *HDLc* high-density lipoprotein cholesterol, *SBP* systolic blood pressure, *DBP* diastolic blood pressure. *BMI* body mass index, *WC* waist circumference. *M* male, *F* female, *Δ* mean percent change in risk factor from the initial visit to the latest visit. Unpaired *t* test and Fisher's exact test were used to detect absolute and relative differences between the initial and latest visits. Data are mean ± SD unless otherwise stated. LDLc data for 12 patients could not be calculated because of high triglyceride levels

Table 4 Factors affecting the achievement of HDLc targets at the latest visit

	HDL targets		<i>p</i>			<i>p</i>
	CHD+			CHD-		
	Reached <i>n</i> = 73	Not reached <i>n</i> = 32		Reached <i>n</i> = 252	Not reached <i>n</i> = 110	
Age (years)	65 ± 10	59 ± 9	<0.01	54 ± 12	52 ± 13	NS
Gender M:F	43:30	21:11	NS	124:128	35:75	<0.01
Initial HDL (mmol/L)	1.4 ± 0.3	1.1 ± 0.3	<0.0001	1.6 ± 0.4	1.2 ± 0.3	<0.0001
HDLc Δ	7.1 %	-6.1 %	<0.05	2.1 %	-9.4 %	<0.0001
LDLc Δ	-4.8 %	-1.5 %	NS	-7.5 %	-8.4 %	NS
SBP Δ	-1.4 %	2.0 %	NS	-3.2 %	0.4 %	<0.05
DBP Δ	-4.8 %	-0.3 %	NS	-5.9 %	-3.3 %	NS
BMI Δ	1.3 %	1.8 %	NS	1.7 %	0.8 %	NS
WC Δ	3.1 %	5.6 %	NS	2.2 %	1.3 %	NS
On lipid Tx initial	64 %	88 %	<0.05	38 %	41 %	NS
On lipid Tx latest	74 %	78 %	NS	71 %	73 %	NS

HDLc high-density lipoprotein cholesterol, *LDLc* low-density lipoprotein cholesterol, *SBP* systolic blood pressure, *DBP* diastolic blood pressure. *BMI* body mass index, *WC* waist circumference, *M* male, *F* female, *Δ* mean percent change in risk factor from the initial visit to the latest visit. Unpaired *t* test and Fisher's exact test were used to detect absolute and relative differences between groups that reached and did not reach HDLc targets. Data are mean ± SD unless otherwise stated

199 patients attended the clinic for >1 year with an average
200 of four to five visits per patient. This should have given
201 ample time for lipid-lowering therapies and lifestyle
202 modifications to take effect. There were no differences in
203 the relative number of patients reaching LDLc targets
204 who attended for less than 12 months. Therefore, it is
205 unlikely that the duration of clinic attendance impacted
206 on the results.

207 It is also noteworthy that many patients were referred to
208 this clinic due to refractoriness to treatment, drug intoler-
209 ances and having co-morbidities such as liver and renal
210 disease which may limit aggressive treatment. In addition,
211 since this is a multiple risk factor clinic, success at
212 achieving some risk factor targets such as smoking cessa-
213 tion and blood pressure control may have influenced the
214 aggressiveness of lipid-lowering strategies. As patients

215 attend the clinic usually on a 6-monthly or annual basis due
216 to limited clinic places, focus on one particular risk factor
217 may have been emphasized more than others.

218 HDLc is gaining increasing importance as an independ-
219 ent cardiovascular risk factor and predictor for cardio-
220 vascular risk [11]. Its levels may improve using statin
221 therapy [12]. However, its manipulation to reduce cardio-
222 vascular events is being questioned [13]. According to the
223 guidelines set out by European Society of Cardiology,
224 HDL levels should be >1.0 mmol/L (40 mg/dL) in males
225 and >1.2 mmol/L (46 mg/dL) in females. In the present
226 study, approximately two-thirds of patients in the clinic had
227 HDLc target levels at baseline. There was no significant
228 change during clinic visits.

229 This reflects the high baseline levels and that statin
230 therapy, while having some beneficial effects on HDLc, is
231 insufficient to appropriately manage low HDLc levels [14].
232 Intensive lifestyle modification in conjunction with niacin
233 and fibrate intervention may improve HDLc status and
234 therefore improve risk factor status in patients with dysli-
235 pidemia [10, 11]. Such strategies need better
236 implementation.

237 Optimization of blood pressure-lowering medication
238 and weight loss are associated with significant reductions
239 in both systolic and diastolic blood pressure [15]. In the
240 present audit, diastolic blood pressure was well managed
241 with over three-quarters of patients reaching targets of
242 <85 mmHg. Patients with CHD had lower DBP compared
243 to those without CHD. This was more than likely due to the
244 fact that those patients diagnosed as having CHD were
245 already prescribed anti-hypertensive medication prior to
246 their initial clinic visit. Despite good diastolic blood pres-
247 sure control, systolic blood pressure control was disap-
248 pointing with just over one-third achieving targets of
249 <130 mmHg. This may reflect ongoing white coat effects
250 at clinic visits, despite underlying blood pressure
251 improvements [16]. Hence, the main focus in clinics had
252 been usage of 24 h blood pressure monitoring. These
253 results are similar to the findings of the latest EUROAS-
254 SPIRE study which recorded that only 39 % of patients
255 achieved BP targets of 140/80 and 130/80 mmHg in
256 patients with diabetes [6]. Assessing the cardiovascular risk
257 factors as a whole and implementing earlier pharmaco-
258 logical and weight loss interventions before patients reach
259 a hypertensive state could help manage the increasing
260 burden of systolic blood pressure [17].

261 In the present study, despite the availability of smoking
262 cessation treatments, one-fifth of patients continued
263 smoking. Previous studies have shown that smoking ces-
264 sation reduces the likelihood of recurrent cardiovascular
265 events in patients with coronary heart disease [18]. How-
266 ever, quitting smoking is physiologically and psychologi-
267 cally very challenging and many patients are not suitable

268 for pharmacologic smoking cessation intervention due to
269 history of anxiety and depression. More “holistic-type”
270 programs not using pharmacological intervention have
271 reported significant improvements in smoking cessation.
272 Therefore, a dedicated smoking cessation program in
273 conjunction with the risk factor clinic may be warranted
274 [19].

275 Obesity has been shown to have a negative impact on
276 other cardiovascular risk factors including dyslipidemia,
277 raised blood pressure and type II diabetes [20]. Weight loss
278 is associated with improvements in blood pressure, total
279 cholesterol, LDLc, triglycerides, glucose and HDLc.
280 Therefore, weight loss is critical for reducing the cardio-
281 vascular risk profile of obese patients [20]. Over half of the
282 patients attending the clinic were obese, significantly but
283 not surprisingly higher than the Irish population average of
284 25 % [22]. These findings are similar to that of the latest
285 EUROASPIRE where 83 % of patients had a
286 BMI ≥ 25 kg/m² and 38 % had ≥ 30 kg/m². Significant
287 improvements in BMI were not observed in those without
288 CHD. However, weights actually increased in those with
289 CHD during clinic visits. This may be due to an initial
290 change in patients’ weight once CHD was diagnosed and a
291 relaxation or refocus once other risk factor management
292 was in place.

293 Previous studies that have adopted intense exercise
294 interventions have been successful [20]. Drug interventions
295 to achieve weight loss may have adverse side effects with
296 only modest effects on weight loss and therefore were not
297 considered as a first-line treatment for obese patients at our
298 clinic [23]. Current medical focus is placed more on the
299 management of the complications of obesity such as
300 hypertension, dyslipidemia and diabetes rather than the
301 source of many of these problems which is obesity itself. In
302 clinical practice, cardiovascular risk factors governed by
303 lifestyle such as smoking, BMI and waist circumference
304 are the most difficult to manage.

305 In summary, our retrospective audit highlights many
306 successes and a number of apparent failures. Some expla-
307 nations for both have been considered. It is particularly
308 important to note that in modern clinical practice with the
309 increasing awareness about cardiovascular risk factors, the
310 best results occur in the community. Patients whose risk
311 factors are well controlled rarely reach the hospital risk
312 factor clinic. Thus, this audit pertains to the patients who
313 were not “cherry picked” for success. As observed in other
314 studies, the cardiovascular risk factors that were managed
315 primarily through medications were better controlled than
316 those primarily improved by lifestyle changes. More
317 emphasis needs to be placed on weight reduction and
318 smoking cessation therapies, as successful management of
319 these risk factors have been shown to lead to improvements
320 in the other cardiovascular risk factors. The

321 EUROACTION preventative cardiology program shows
322 that with a professional, comprehensive and multidisciplinary
323 program, lifestyle changes can be achieved leading
324 to weight loss, reduced central obesity, reduced blood
325 pressure and improved blood cholesterol concentrations.
326 Barriers to prevention programs such as these include lack
327 of time, prescribing costs and poor patient compliance.
328 However, the feasibility of such programs should be further
329 explored as they address the risk factors most clinicians
330 find difficult to manage.

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335

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