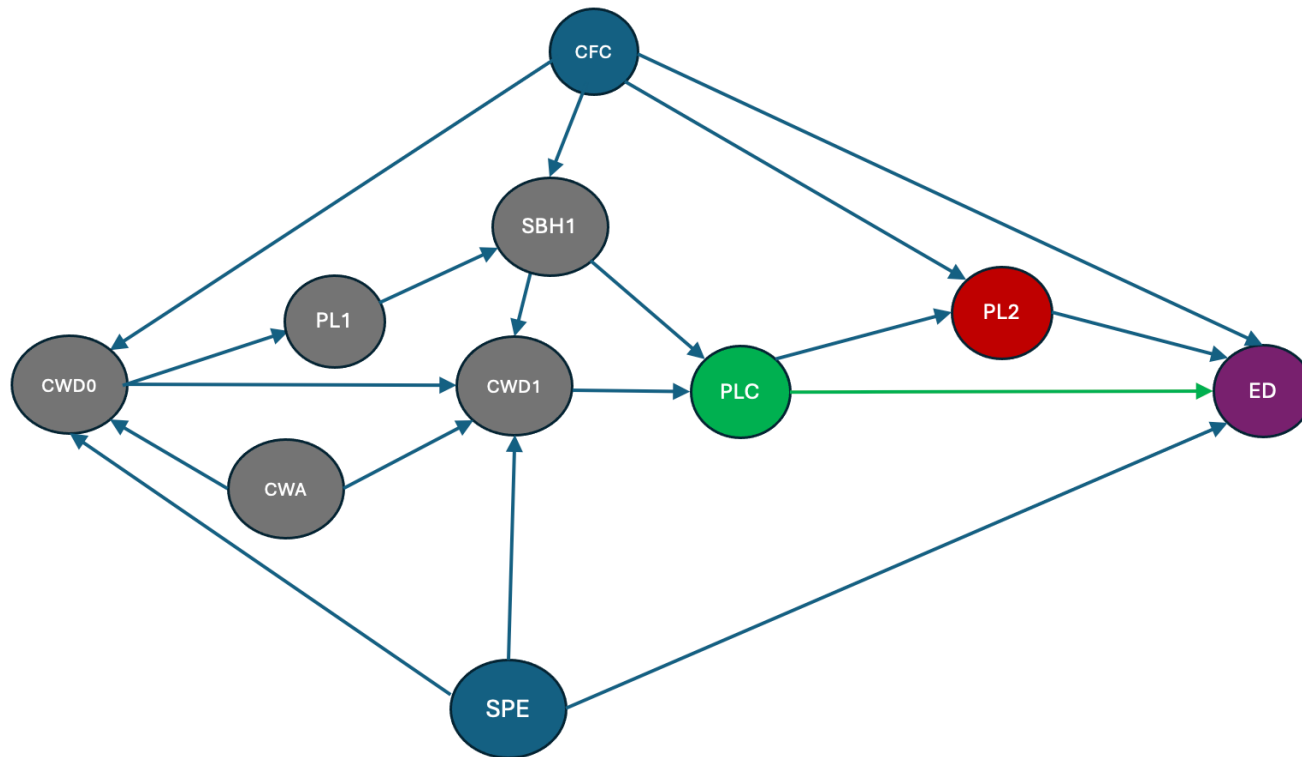DAG showing causal effect of placement changes, PLC, on educational outcomes, ED:

Placement Change PLC - Treatment
ED - Academic Outcome - DV

Abbreviation Variable Label
CFC   C/F Char = child/family characteristics (includes safety/BH before first pl)
CW0   CW Decision 0 = Case worker decision leading to placement 1
PL1   PL-1 = placement 1 (first placement in foster care)
SBH1   Safety/BH 1 = Safety or behavioral health information after first placement
CW1   CW Decision 1 = case worker decision following placement 1 leading to placement 2
SPE   Social & Political Enviroment (basically an omnibus county/agency level variable)
PLC   PL Change = Placement change - the change from pl 1 to pl 2
PL2   PL-2 = the resulting second placement

This is the full numbered inventory:

#	PLC < ... > ED	SBH1	CFC	PL2	PL1	CW0	SPE	CW1
1	SBH1 < CFC > PL2	SBH1	CFC	PL2				
2	SBH1 < CFC	SBH1	CFC					
3	SBH1 < PL1 < CW0 < CFC > PL2	SBH1	CFC	PL2	PL1	CW0		
4	SBH1 < PL1 < CW0 < CFC	SBH1	CFC		PL1	CW0		
5	SBH1 < PL1 < CW0 < SPE	SBH1			PL1	CW0	SPE	
6	CW1 < SBH1 < CFC > PL2	SBH1	CFC	PL2				CW1
7	CW1 < SBH1 < CFC	SBH1	CFC					CW1
8	CW1 < SBH1 < PL1 < CW0 < CFC > PL2	SBH1	CFC	PL2	PL1	CW0		CW1
9	CW1 < SBH1 < PL1 < CW0 < CFC	SBH1	CFC		PL1	CW0		CW1
10	CW1 < SBH1 < PL1 < CW0 < SPE	SBH1			PL1	CW0	SPE	CW1
11	CW1 < CW0 < CFC > PL2		CFC	PL2		CW0		CW1
12	CW1 < CW0 < CFC		CFC			CW0		CW1
13	CW1 < CW0 < SPE					CW0	SPE	CW1
14	CW1 < SPE						SPE	CW1

Steps I and II: identify mediators for overcontrol (cannot condition); and colliders (could condition if necessary); cross off the mediators, box-in the colliders.

#	PLC <	> ED	SBH1	CFC	PL2	PL1	CW0	SPE	CW1
1	SBH1 < CFC > PL2		SBH1	CFC	PL2				
2	SBH1 < CFC		SBH1	CFC					
3	SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		
4	SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		
5	SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	
6	CW1 < SBH1 < CFC > PL2		SBH1	CFC	PL2				CW1
7	CW1 < SBH1 < CFC		SBH1	CFC					CW1
8	CW1 < SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		CW1
9	CW1 < SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		CW1
10	CW1 < SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	CW1
11	CW1 < CW0 < CFC > PL2			CFC	PL2		CW0		CW1
12	CW1 < CW0 < CFC			CFC			CW0		CW1
13	CW1 < CW0 < SPE						CW0	SPE	CW1
14	CW1 < SPE							SPE	CW1
	Notes about Steps I and II		Collider		Mediator (Overcontrol)		Collider		Collider

Steps III and IV - look for single variables on row; there are none; look for pairs, and there are 2; circle these and cross off all of the rows with these pairs
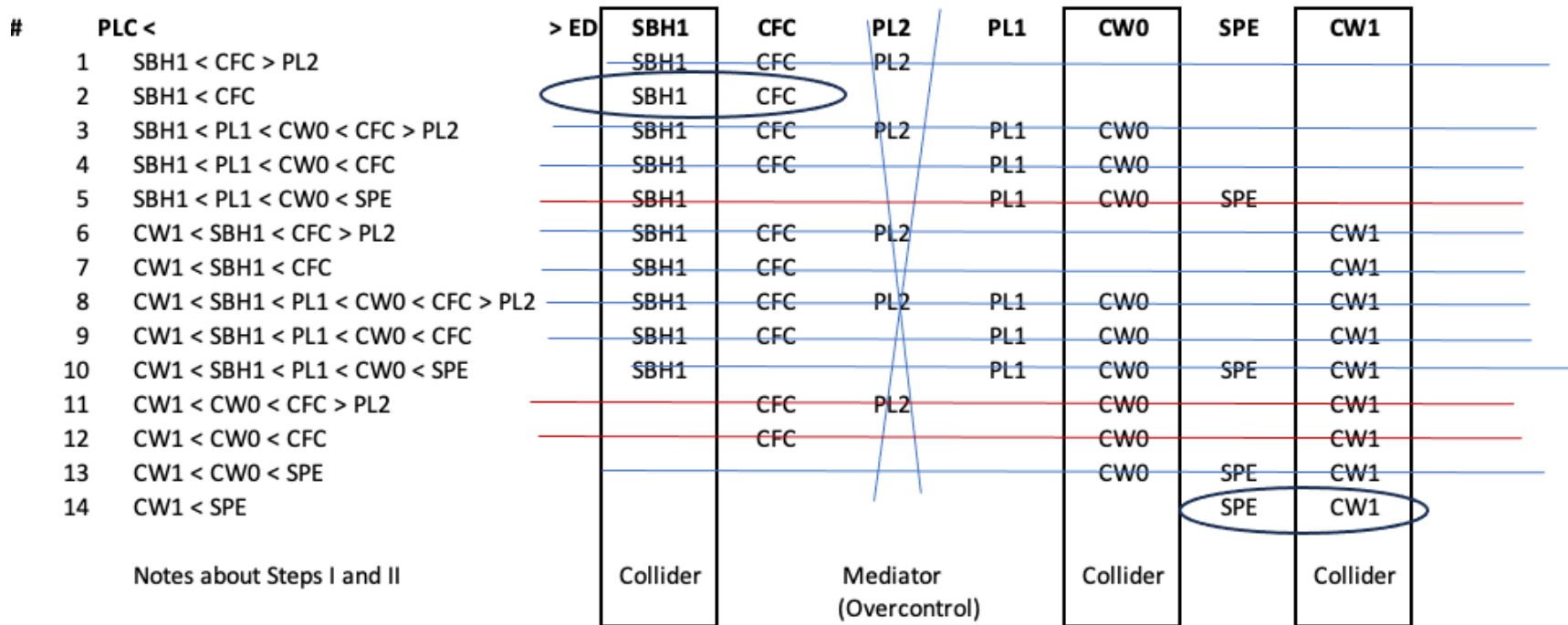
#	PLC <	> ED	SBH1	CFC	PL2	PL1	CW0	SPE	CW1
1	SBH1 < CFC > PL2		SBH1	CFC	PL2				
2	SBH1 < CFC		SBH1	CFC					
3	SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		
4	SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		
5	SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	
6	CW1 < SBH1 < CFC > PL2		SBH1	CFC	PL2				CW1
7	CW1 < SBH1 < CFC		SBH1	CFC					CW1
8	CW1 < SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		CW1
9	CW1 < SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		CW1
10	CW1 < SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	CW1
11	CW1 < CW0 < CFC > PL2			CFC	PL2		CW0		CW1
12	CW1 < CW0 < CFC			CFC			CW0		CW1
13	CW1 < CW0 < SPE						CW0	SPE	CW1
14	CW1 < SPE							SPE	CW1
	Notes about Steps I and II		Collider		Mediator (Overcontrol)		Collider		Collider

Note about Step III & IV: Pairs are SBH1 & CFC; and SPE & CW1. As a result all rows except 5, 11, & 12 are crossed off. These remaining rows have one member of each of these pairs, so they can't just be crossed off. But two strategies are possible, which we describe below.

Strategy A: conditional re-application of Steps III and IV: choose one member of each pair, and cross off lines with that member (For now, choose SBH1 and CW1), then reapply this step using a different member of each pair. This suggests the following minimum sets, given that they result in rows 5, 11, and 12 being crossed off: SBH1, CW1; CFC, SPE.

#	PLC <	> ED	SBH1	CFC	PL2	PL1	CW0	SPE	CW1
1	SBH1 < CFC > PL2		SBH1	CFC	PL2				
2	SBH1 < CFC		SBH1	CFC					
3	SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		
4	SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		
5	SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	
6	CW1 < SBH1 < CFC > PL2		SBH1	CFC	PL2				CW1
7	CW1 < SBH1 < CFC		SBH1	CFC					CW1
8	CW1 < SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		CW1
9	CW1 < SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		CW1
10	CW1 < SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	CW1
11	CW1 < CW0 < CFC > PL2			CFC	PL2		CW0		CW1
12	CW1 < CW0 < CFC			CFC			CW0		CW1
13	CW1 < CW0 < SPE						CW0	SPE	CW1
14	CW1 < SPE							SPE	CW1
	Notes about Steps I and II		Collider		Mediator (Overcontrol)		Collider		Collider

Notes about Strategy A (Choice of SBH1 and CW1): all lines are accounted for (the red lines crossing off 5, 11, and 12). But note that both of these variables are colliders, which lead to the opening of colliding paths (e.g., doing so leads the path PL1 > SBH1 < CFC, meaning that PL1 must now be controlled for.) If we could choose variables that are not colliders that would, in general, be better. In fact, if we choose CFC and SPE, we get the same solution but without colliders. Strategy B a priori rules out colliders first.

Strategy B: If possible, rule out conditioning on colliders first; this leads to choice of CFC (removes rows 11 and 12) and SPE (removes row 5).

#	PLC <	> ED	SBH1	CFC	PL2	PL1	CW0	SPE	CW1
1	SBH1 < CFC > PL2		SBH1	CFC	PL2				
2	SBH1 < CFC		SBH1	CFC					
3	SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		
4	SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		
5	SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	
6	CW1 < SBH1 < CFC > PL2		SBH1	CFC	PL2				CW1
7	CW1 < SBH1 < CFC		SBH1	CFC					CW1
8	CW1 < SBH1 < PL1 < CW0 < CFC > PL2		SBH1	CFC	PL2	PL1	CW0		CW1
9	CW1 < SBH1 < PL1 < CW0 < CFC		SBH1	CFC		PL1	CW0		CW1
10	CW1 < SBH1 < PL1 < CW0 < SPE		SBH1			PL1	CW0	SPE	CW1
11	CW1 < CW0 < CFC > PL2			CFC	PL2		CW0		CW1
12	CW1 < CW0 < CFC			CFC			CW0		CW1
13	CW1 < CW0 < SPE						CW0	SPE	CW1
14	CW1 < SPE							SPE	CW1
	Notes about Steps I and II		Collider	Mediator (Overcontrol)			Collider		Collider