필요충분조건

bATG13 < 0

WULK1 + bATG13 > 0

bATG5 < 0

WULK1 + bATG5 > 0

WFOXO3 + bATM/ATR < 0 (WFOXO3 \* XFOXO3 + bATM/ATR < 0; regardless of XFOXO3)

WDNAdamage + bATM/ATR > 0 (WDNAdamage + WFOXO3 \* XFOXO3 + bATM/ATR > 0; regardless of XFOXO3)

bATM/ATR\_2 < 0

WDNAdamage\_high + bATM/ATR\_2 > 0

bE2F1 > 0

–WRB1 + bE2F1 < 0

WATM/ATR – WRB1 + bE2F1 < 0

bG6PC < 0

WFOXO3 + bG6PC > 0 (H(WFOXO3 \* XFOXO3 + bG6PC) = XG6PC; cascade)

bGlucose < 0

WSLC2A4 + bGlucose > 0 (H(WSLC2A4 \* XSLC2A4 + bGlucose) = XGlucose; cascade)

bHIPK2 < 0

WATM/ATR\_2 + bHIPK2 > 0 (H(WATM/ATR\_2 + bHIPK2) = XHIPK2; cascade)

bIGF1R < 0 (H(bIGF1R) = XIGF1R; makes sense to be off if no signal present for IGF1R)

WIGF1 + bIGF1R > 0 (H(WIGF1 + bIGF1R) = XIGF1R; as IGF1R is sole recipient of IGF1 signal, it needs to be on if IGF1 present)

WIGF1 – WTP53 + bIGF1R > 0 (H(WIGF1 – WTP53 + bIGF1R) = XIGF1R; as IGF1R is sole recipient of IGF1 signal, it needs to be on if IGF1 present)

WTP53\_s46 == 0 (H(–WTP53\_s46 + bIGF1R) = XIGF1R; WTP53\_s46 nonfunctional)

bIL1B < 0

WNFKB1 + bIL1B > 0

bIL6 < 0

WNFKB1 + bIL6 > 0

bINSR > 0

-WlowNutrition + bINSR < 0 (H(-WlowNutrition + bINSR) = XINSR; cascade)

bMAPK14 < 0

WMAP2K3/MAP2K6 + bMAPK14 > 0(H(WMAP2K3/MAP2K6 \* XMAP2K3/MAP2K6 + bMAPK14) = XMAPK14; cascade)

bNAD+ < 0

WAMPK + bNAD+ > 0 (H(WAMPK \* XAMPK + bNAD+) = XNAD+; cascade)

bRHEB > 0

-WTSC2 + bRHEB < 0 (H(-WTSC2 \* XTSC2 + bRHEB) = XRHEB; cascade)

bS6K1 < 0

WMTOR + bS6K1 > 0

bSOD2 < 0

WFOXO3 + bSOD2 > 0 (H(WFOXO3 \* XFOXO3 + bSOD2) = XSOD2; cascade)

bTCA cycle < 0

WGlycolysis + bTCA cycle > 0 (H(WGlycolysis \* XGlycolysis + bTCA cycle) = XTCA cycle; cascade)

bTNF < 0

WNFKB1 + bTNF > 0

-WAMPK + bULK1 > 0

–WMTOR + bULK1 < 0

bKRAS < 0

WINSR + WIGF1R + bKRAS > 0

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-WATP +bADP/ATP < 0

WlowNutrition +bADP/ATP > 0

-WATP + bAMP/ATP < 0

WlowNutrition + bAMP/ATP > 0

WTP53 + bAMPK < 0

WADP/ATP + WAMP/ATP + WlowNutrition + bAMPK > 0

bATP < 0 (WGlycolysis \* XGlycolysis + WTCA cycle \* XTCA cycle + bATP < 0; cascade, because XTCA cycle is cascade of XGlycolysis)

WGlycolysis + WTCA cycle + bATP > 0 (WGlycolysis \* XGlycolysis + WTCA cycle \* XTCA cycle + bATP > 0; cascade, because XTCA cycle is cascade of XGlycolysis)

WBAX + WCASP9 + bCASP3 > 0

WBAX + bCASP3 < 0 (WBAX \* XBAX + bCASP3 < 0; regardless of XBAX)

bCDK4 > 0

-WCDKN1A + bCDK4 < 0

-WCDKN2A + bCDK4 < 0 (-WCDKN1A \* XCDKN1A – WCDKN2A \* XCDKN2A + bCDK4 < 0; XCDKN1A or XCDKN2A needs to be 1; if latter, this needs to be true)

bEIF4EBP1 > 0

-WMTOR + bEIF4EBP1 < 0 (-WMAPK1 \* XMAPK1 – WMTOR + bEIF4EBP1 < 0; regardless of XMAPK1)

WMAPK1 == 0 (-WMAPK1 \* XMAPK1 – WMTOR + bEIF4EBP1 < 0; WMAPK1 nonfunctional because of above inequality)

-WSIRT1 + bNFKB1 > 0 (-WSIRT1 \* XSIRT1 + bNFKB1 > 0; regardless of XSIRT1)

-WNFKBIE + bNFKB1 < 0 (-WSIRT1 \* XSIRT1 – WNFKBIE + bNFKB1 < 0; regardless of XSIRT1)

bNFKBIE > 0 (-WIKBKB \* XIKBKB + bNFKBIE > 0; XIKBKB == 0, because of above inequality)

WNFKB1 – WIKBKB + bNFKBIE < 0 (WNFKB1 – WIKBKB \* XIKBKB + bNFKBIE < 0; XIKBKB == 1, because of below inequality)

-WMDM2 + bRB1 > 0 (-WMDM2 \* XMDM2 + bRB1 > 0; regardless of XMDM2)

-WCDK4 + bRB1 < 0 (-WCDK4 – WMDM2 \* XMDM2 + bRB1 < 0; regardless of XMDM2)

bIRS1 < 0

WINSR + WIGF1R – WS6K1 + bIRS1 > 0

IPT 1: H(WINSR + WIGF1R – WS6K1 – WIKBKB + bIRS1) = XIRS1

bPIK3CA < 0

WKRAS + WIRS1 + bPIK3CA > 0

IPT 2: H(WKRAS + WIRS1 \* XIRS1 + bPIK3CA) = XPIK3CA

WROS == 0 (H(WROS \* XROS + bDNAdamage) = XDNAdamage; WROS nonfunctional)

WTP53 == 0 (H(-WTP53 \* XTP53 + bIGF1) = XIGF1; WTP53 nonfunctional)

(regardless 조건들: 수식 상 용인 가능한 충분조건들)

Derived

COND 1 2 3 4

XHIPK2 0 0 1 0

XIGF1R 1 0 0 1

XINSR 1 OPT 0 1

XNAD+ 0 1 1 0

XKRAS 1 0 0 1

XMAPK1 1 0 0 NK

Primary constraints--------------------------------------------------

XCDK4 0 OPT OPT OPT

XIKBKB 1 0 0 0

XGlu NK 1 1 NK

XGlycoly 1 0 0 1

XTCA 1 0 0 1

XIRS1 NK 0 0 1

XPIK3CA NK 0 0 1